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(54) **MONITORING SYSTEM**

ÜBERWACHUNGSSYSTEM

SYSTÈME DE SURVEILLANCE

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Description**FIELD OF THE INVENTION**

5 **[0001]** This invention relates to dispenser usage and in particular to a system and a method of monitoring dispenser usage which can be correlated to hand hygiene compliance or other dispenser usage compliance.

BACKGROUND OF THE INVENTION

10 **[0002]** The spread of healthcare acquired infections also known as HAI's has been an ever increasing challenge in health care facilities. HAI's include the transmission of bacteria, viruses and other disease-causing micro-organisms from various sources such as a patient or environmental surfaces to another patient or surface via the hands of healthcare workers which results in an infection of a patient that was previously not infected. These problems have been more apparent in recent years with the SARS (severe acute respiratory syndrome) outbreak and the influenza A virus H1N1
 15 pandemic. As well, health care facilities have battled MRSA (methicillin-resistant staphylococcus aureus) and VRSA (vancomycin-resistant staphylococcus aureus) and other drug resistant micro-organisms for many years. Accordingly, there is a need to ensure that health care professionals comply with hand hygiene best practices. Hand hygiene can be accomplished using liquids such as a sanitizing product which does not require water or rinsing off or alternatively it can be accomplished using a soap and water.

20 **[0003]** As well there are other types of liquids that can be dispensed such as sun screen wherein the use of the sun screen similarly needs a method of monitoring, tracking and reporting. For example such a method could be very important in schools in Australia where the incidences of skin cancer are very high.

[0004] US 2009/195385 discloses a system consisting of remote identification tag (in the form of wristband) for personnel who must undergo hand hygiene frequently during a day's work, programmed soap and rinse-free disinfectant dispensers, entry-exit sensors for controlled access areas and data transfer stations is used to monitor and record every
 25 handwashing procedure along with its thoroughness as well as every hand cleaning event with rinse-free disinfectant.

[0005] Code of Federal Regulations- telecommunication discloses various broadcast and transmission telecommunication channels.

[0006] US 2009/299787 discloses a hand hygiene station and method of monitoring a complete hand hygiene station.
 30 The complete hand hygiene station may include at least an automated wash cylinder or chamber, a sanitizer dispenser and a lotion dispenser. The wash chamber and/or the sanitizer dispenser may be used to provide a user with a hand washing. The lotion dispenser may be used to moisturize a user's hands after the usage of the sanitizer dispenser. The complete hand hygiene station may be monitored to ensure compliance with one or more hygiene protocols.

[0007] US 2010/155416 discloses a system to allow employers to monitor employee handwashing or hand sanitization
 35 compliance in a facility with a plurality of touchless dispensers for metering a cleanser, disinfectant or lotion on the hands of a user.

SUMMARY OF THE INVENTION

40 **[0008]** There is provided a system and method as defined in the appended claims.

[0009] Further features of the invention will be described or will become apparent in the course of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

45 **[0010]** The invention will now be described by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a sketch showing the five moments for hand hygiene in a healthcare setting;
 50 Fig. 2 is a graph showing the compliance index of pediatrics as compared to the facility goal and the hospital aggregate;
 Fig. 3 is a graph showing the compliance index of the intensive care unit as compared to the facility goal and the hospital aggregate;
 Fig. 4 is flow chart showing different methods for calculating the hand hygiene compliance index;
 Fig. 5 is a sample dashboard showing an example of the way information may be presented to a user;
 55 Fig. 6 is a diagram showing a wired dispenser data collection system;
 Fig. 7 is a diagram showing a wireless dispenser data collection system similar to that shown in figure 6;
 Fig. 8 is a flow diagram showing the steps in a low frequency, low power wireless dispenser data collection system shown by way of a non-claimed example;

Fig. 9 is a flow diagram showing the steps in a higher frequency, higher power wireless dispenser data collection system according to the present invention;

Fig. 10 is a diagram showing a lower power and lower frequency dispenser data collection system over a specific area by way of a non-claimed example; and

Fig. 11 is a diagram showing a higher power and higher frequency dispenser data collection system over the same specific area as covered in figure 10 according to the claimed invention.

DETAILED DESCRIPTION OF THE INVENTION

[0011] Measuring healthcare worker adherence to hand hygiene compliance guidelines is not a simple matter. There are no proven standards or benchmarks that may be used. However there is a very clear need to monitor and measure hand hygiene compliance. Accordingly there is a need to determine whether or not a hand hygiene action occurred when there was an indication for a hand hygiene action. The five moments for hand hygiene actions in a healthcare setting are shown in figure 1. These five moments of hand hygiene were developed by the World Health Organization. Hand hygiene actions can be sanitizing with a sanitizing product which does not require water or rinsing off or alternatively it can be washing with soap and water.

[0012] As used herein, the term "hub" refers to any network device capable of sending and receiving packets of information and is not to be interpreted as limited to Ethernet hubs, network hubs, or repeater hubs traditionally described in computer network literature.

[0013] As used herein, the phrase "operably connected" or "operably attached", e.g. "X is operably connected to Y" or "X is operably attached to Y", indicates that X and Y may causally influence each other in operation, though X and Y do not necessarily have to be physically connected or physically attached. In this phrase, the terms "connected" and "attached" are to be interpreted in an operational sense, and not necessarily a physical sense. For example, if X and Y are devices capable of sending packets to one another either directly or through a network, then X and Y are operably connected. As a further example, if X is a device and Y is a sensor, and Y is capable of sensing one or more events occurring as a result of the operation of X, then X and Y are operably connected.

[0014] Referring to figure 1 the five moments of hand hygiene action are shown generally at 10. Specifically they are before patient contact 12, before aseptic task 14, after body fluid exposure risk 16, after patient contact 18 and after contact with patient surroundings 20. When considering compliance, if a health care worker only washes or sanitizers his or her hands 6 out of the 10 times that they should have, they are said to exhibit a compliance rate of 60%.

[0015] There are a number of ways to measure compliance namely direct observation, remote observation, self-reporting and dispenser usage data or product usage data. Each way has its own benefits and challenges. Specifically direct observation provides specific information on hand hygiene behaviors, techniques and indication. However, the labor and resources required to collect such data is intensive. Generally if this type of data is collected it is only collected for a small sample of the total of hand hygiene opportunities and thus has a typically low level of statistical reliability. The data is subject to bias from over or under sampling of certain shifts and units. As well, it has been shown that there are also issues regarding inter-rater (observer) reliability and therefore it is difficult to compare the results from one observer or rater with another.

[0016] Further, it has been shown that if people know they are being watched or studied there is a greater likelihood that the compliance rate will be artificially higher than in reality. This is known as the Hawthorne Effect. Evidence supporting this is found in a 2009 German study that compared product usage data with direct observation data and found that the direct observation compliance rate was 2.75 times higher than that for product usage. Thus product usage is gaining acceptance by professionals as a more accurate measure of true compliance rates.

[0017] In regard to remote observation such as video the advantage is that it is less subject to bias and it can operate at any time of day or night and in any unit. However, such a method of data collection is expensive because of the installation and maintenance of the video equipment as well as the time to review the video, such review is then subject to the same lack of inter-rater reliability as direct observation. Further, it can be subject to bias based on the video location. Further, there may be privacy issues in regard to video locations.

[0018] In regard to the self-reporting option, this has the advantage of being low cost and it encourages health care workers with respect to hand hygiene self-awareness. However, in general this type of data collection has poor reliability and most experts in the field consider this method of little, if any, value.

[0019] In typical healthcare environments, hand hygiene liquids are stored and dispensed onto the hands from dispensers, therefore there is a direct correlation between dispenser usage or activations and hand hygiene events being performed. Dispenser usage data can provide the product volume used per patient day or the number of times the dispenser was used per patient day. This has the advantage of being less costly to monitor. Further, it provides an overall measure of use and it is not subject to selection bias. However, it does not provide feedback for indications or technique. Further, it does not identify low-performing individual staff members. There are a number of further advantages to measuring dispenser usage. Specifically in addition to being less costly it is less resource intense and therefore more

efficient than observation. As well it can be done manually or electronically. It allows organization-wide trends to be tracked over time. It can be unobtrusive and designed to take up little additional space. Dispenser usage can be easily measured across all shifts, twenty-four hours a day, and seven days a week. It requires minimal staff training. It can easily be done in many different healthcare settings.

[0020] In the embodiments herein the dispensers are capable of determining when the dispensers are activated. The number of dispenser usage events within a predetermined time period equals the number of times the dispenser has been activated and a plurality of activations within a predetermined activation period is considered a single dispenser usage event. It will be appreciated by those skilled in the art that a plurality of activations within a short period of time will typically mean one user has activated the dispensers a plurality of times rather than multiple users activating the dispenser very close together. Therefore, a plurality of activations within a 1 to 4 second time frame will be considered a single dispenser usage event. For hand soaps and hand sanitizers in a healthcare facility, this will typically be set at 2.5 seconds. However, where dispenser usage is being monitored for different types of products in different types of facilities, this may be set for a different activation period. Typically dispensers are calibrated to dispense a predetermined amount of liquid for each activation. Accordingly, the dispenser activation directly relates to product usage. Accordingly it will be appreciated by those skilled in the art that when determining a dispenser usage compliance index one could measure volume used or dispenser activations.

[0021] In one embodiment dispenser usage alone is used to calculate a dispenser usage compliance index. In another embodiment, a combination of two or more of dispenser usage data, direct observation data and survey data (for example self reporting data or patient survey data) may be used to provide consolidated hand hygiene information. Preferably the information would be automated and in real time. In one embodiment the system would provide automated multi-modal hand hygiene compliance reports. Preferably these reports could be presented by unit and or department. Such automated reporting would provide the hospital's management with the tools to give feedback on compliance adherence; target interventions designed to improve compliance; and reward improved performance.

[0022] In one embodiment the hand hygiene compliance index will include a plurality of modes of determining compliance. Specifically it will include data from dispenser usage, observation and/or surveys. Each method is weighted and then combined to create a single index of compliance. The methods are weighted based on, for example, their statistical reliability

[0023] To determine the measure of compliance by dispenser usage the facility being monitored is provided with a plurality of dispensers. The facility may be divided into predetermined groups of interest. The facility may be a teaching hospital, a non-teaching hospital, a long term care facility, a rehabilitation facility, a free standing surgical center, a health care professional office, a dental office, a veterinarian facility and a community care facility as well as other health care settings in which hand hygiene compliance is an important issue. Alternatively the system herein may be used in any facility wherein the hand hygiene needs to be monitored such as at various stages in food preparation including abattoirs, preparing precooked foods and restaurants. The monitoring system could also be used for monitoring compliance with applying such dispensed lotions as sunscreen.

[0024] In order to determine dispenser usage compliance one needs the number of hand hygiene events and a benchmark for a predetermined area or group and for a predetermined time. The dispenser usage compliance is the dispenser usage events divided by a denominator wherein the denominator includes at least in part the benchmark. The benchmark is particular to the predetermined group and particular to the predetermined time period. The usage may be measured for each dispenser in the predetermined group in practically real time and the captured data is transmitted electronically. It will be appreciated by those skilled in the art that there is a limited amount of time required for the data to get from the dispenser, to the hub to the server (described below) but this could be set for the messages to be transmitted very frequently. While access to the reports is available twenty-four hours, seven days a week, typically, however, the reports would most likely be presented no more than daily and more likely weekly or monthly. However, if there was a particular outbreak on a ward the usage of the dispenser could be monitored more frequently by accessing the reports on demand. The number of hand hygiene events within a predetermined time period equals a number of times the dispenser has been activated and wherein multiple activations within a predetermined activation period are considered a single dispenser usage event. It is not uncommon that when someone uses a dispensing system that rather than merely activating once they activate the dispenser multiple times. Accordingly to accurately determine the correct number of dispenser usage events the number of times the dispenser is activated is determined. However where there are multiple activations within a predetermined activation period that is considered a single dispenser usage event. The benchmark is the number of times the dispenser should have been used for a predetermined group over a predetermined time period.

[0025] When the dispenser usage compliance relates to hand hygiene compliance in a healthcare facility, the benchmark relates to the five moments of hand hygiene for a predetermined group over a predetermined time period. To determine the benchmark for the predetermined area and time, one needs to determine the hand hygiene occurrences that should occur per patient for the predetermined area and time. This is done with reference to the five moments of hand hygiene as shown in figure 1. It will be appreciated by those skilled in the art that the benchmark will be different

depending on a number of variables. For example if the healthcare facility is a teaching facility it is likely that more healthcare professionals will need to see the patient and therefore the benchmark may be higher. The benchmark may vary if the predetermined period is a night shift versus a day shift; if it is a weekday versus a holiday or weekend. The benchmark will likely vary depending on the type of unit. For example an intensive care unit will likely have a higher benchmark than an orthopedic unit. The denominator may be dependent on the census data. Specifically to determine the denominator the benchmark is multiplied by the census data. For some healthcare facility units or the predetermined group of interest the census data will be the bed occupancy. In some health care facilities or in particular units of the facility this may always be close to 100% whereas in other units or facilities this may vary greatly. In other units, for example, an emergency unit or an outpatient unit, the census data might be the number of patients seen during the shift or over the predetermined time period that is at issue. It may also be the number of bed-hours of care provided during the predetermined time period that is at issue.

[0026] Further, it will be appreciated by those skilled in the art that the benchmark may be determined through experiments or other means by the healthcare facility or there may be default benchmarks provided which are provided to the user by the dispenser provider or a central authority.

[0027] The following are some of the categories which may be used to determine the correct benchmark. The group or types set out below that relate to healthcare facilities and the types of units within them are the Center for Disease Control (CDC) location labels and are by way of example only. It will be appreciated by those skilled in the art that there are a number of different ways of dividing up the units in a healthcare facility.

Facility Types - Healthcare

[0028]

- Hospital - non teaching
- Hospital - teaching (affiliated with medical school)
- Rehabilitation Facility
- Long Term Care Facility
- Free Standing Surgical Center
- Medical/physician office
- Dental office
- Veterinarian Office

Facility Types - non healthcare

[0029]

- School/educational
- Correctional
- Military
- Food service (such as a restaurant)
- Food processing (such as a manufacturer of food products)
- Pharmaceutical production
- Commercial building/organization (such as a manufacturer where workers must apply protective creams routinely)
- Other facilities where spread of infections by hands is a concern

Adult Critical Care Units

[0030]

- Burn Critical Care
- Medical Cardiac Critical Care
- Medical Critical Care
- Medical/Surgical Critical Care
- Neurologic Critical Care
- Neurosurgical Critical Care
- Prenatal Critical Care
- Respiratory Critical Care
- Surgical Cardiothoracic Critical Care

Surgical Critical Care
Trauma Critical Care

Pediatric Critical Care Units

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[0031]

Pediatric Burn Critical Care
Pediatric Cardiothoracic Critical Care
10 Pediatric Medical Critical Care
Pediatric Medical/Surgical Critical Care
Pediatric Neurology Critical Care
Pediatric Neurosurgical Critical Care
Pediatric Respiratory Critical Care
15 Pediatric Surgical Critical Care
Pediatric Trauma Critical Care

Neonatal Units

20

[0032]

Well Baby Nursery (Level I)
Step down Neonatal ICU (Level II)
Neonatal Critical Care (Level II/III)
25 Neonatal Critical Care (Level III)

Inpatient Specialty Care Areas

[0033]

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Long Term Acute Care (LTAC)
Bone Marrow Transplant Specialty Care Area
Acute Dialysis Unit
Hematology/Oncology SCA
35 Solid Organ Transplant SCA
Pediatric Bone Marrow Transplant SCA
Pediatric Dialysis SCA
Pediatric Hematology/Oncology SCA
Pediatric Long-Term Acute Care
40 Pediatric Solid Organ Transplant SCA

Inpatient Adult Wards

[0034]

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Antenatal Care Ward
Burn Ward
Behavioral Health/Psych Ward
Ear/Nose/Throat Ward
50 Gastrointestinal Ward
Gerontology Ward
Genitourinary Ward
Gynecology Ward
Jail Unit
55 Labor and Delivery Ward
Labor, Delivery, Recovery, Postpartum Room (LDRP)
Medical Ward
Medical/Surgical Ward

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10
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Mixed Acuity Ward
Mixed Age, Mixed Acuity Ward
Neurology Ward
Neurosurgical Ward
Ophthalmology Ward
Orthopedic Trauma Ward
Orthopedic Ward
Plastic Surgery Ward
Postpartum Ward
Pulmonary Ward
Rehabilitation Ward
School Infirmary
Surgical Ward
Stroke (Acute) Unit
Telemetry Unit
Vascular Surgery Ward

Inpatient Pediatric Wards

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25
30
35
[0035]
Adolescent Behavioral Health
Pediatric Burn Ward
Pediatric Behavioral Health
Pediatric Ear, Nose, Throat
Pediatric Genitourinary
Medical Pediatric Ward
Pediatric Med/Surg Ward
Pediatric Mixed Acuity (if patients are of mixed age, use Mixed Age found in Inpatient Adult Wards)
Pediatric Neurology Ward
Pediatric Neurosurgical Ward
Pediatric Orthopedic Ward
Pediatric Rehabilitation Ward
Pediatric Surgical Ward

Step Down Units

[0036]

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Step Down Unit
Pediatric Step Down Unit

Operating Rooms

45
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[0037]
Cardiac Catheterization Room/Suite
Cesarean Section Room/Suite
Interventional Radiology
Operating Room/Suite
Post Anesthesia Care Unit/Recovery Room

Long Term Care

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[0038]
Inpatient Hospice
Long Term Care Unit

Long Term Care Alzheimer's Unit
 Long Term Care Behavioral Health/Psych Unit
 Ventilator Dependent Unit
 Long Term Care Rehabilitation Unit

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Laboratory Identified Event (LabID) Only

[0039]

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Facility-wide Inpatient
 Facility-wide Outpatient

Miscellaneous Areas

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[0040]

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All Inpatient Beds Combined
 Float
 Sleep Studies (for in and out patients)
 Pulmonary Function Testing
 Transport Service
 Treatment Room

OUTPATIENT LOCATIONS

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Acute Care Settings

[0041]

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24-Hour Observation Area
 Ambulatory Surgery Center
 Facility-wide Outpatient
 Mobile Emergency Services/EMS
 Outpatient Emergency Department
 Outpatient Pediatric Surgery Center
 Outpatient Plastic Surgery Center
 Outpatient Surgery Recovery Room/Post Anesthesia Care Unit
 Pediatric Emergency Department
 Therapeutic Apheresis Unit
 Urgent Care Center

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Clinic (Nonacute) Settings

[0042]

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Allergy Clinic
 Behavioral Health Clinic
 Blood Collection Center
 Cardiac Rehabilitation Center
 Cardiology Clinic
 Continence Clinic
 Dermatology Clinic
 Diabetes/Endocrinology Clinic
 Ear, Nose, Throat Clinic
 Family Medicine Clinic
 Genetics Clinic
 Gynecology Clinic
 Holistic Medicine Center

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Hyperbaric Oxygen Center
 Infusion Center
 Neurology Clinic
 Occupational Health Clinic
 Occupational Therapy Clinic
 Ophthalmology Clinic
 Orthopedic Clinic
 Ostomy Clinic
 Outpatient Dental Clinic
 Outpatient GI Clinic
 Outpatient Hematology/Oncology Clinic
 Outpatient Hemodialysis Clinic
 Outpatient HIV Clinic
 Outpatient Medical Clinic
 Outpatient Rehabilitation Clinic
 Pain Clinic
 Pediatric Behavioral Health Clinic
 Pediatric Cardiology Center
 Pediatric Clinic
 Pediatric Dental Clinic
 Pediatric Dermatology Clinic
 Pediatric Diabetes/Endocrinology Clinic
 Pediatric Gastrointestinal Clinic
 Pediatric Hematology/Oncology Clinic
 Pediatric Nephrology Clinic
 Pediatric Orthopedic Clinic
 Pediatric Rheumatology Clinic
 Pediatric Scoliosis Clinic
 Physical Therapy Clinic
 Physician's Office
 Podiatry Clinic
 Prenatal Clinic
 Pulmonary Clinic
 Rheumatology Clinic
 School or Prison Infirmary
 Specimen Collection Area (Healthcare)
 Speech Therapy Clinic
 Surgical Services Clinic
 Well Baby Clinic
 Wound Center
 Wound Ostomy Continence Clinic
 Endoscopy Suite
 Radiology, includes Nuclear Medicine
 Mobile Blood Collection center
 Mobile MRI/CT

COMMUNITY LOCATIONS

[0043]

Blood Collection (Blood Drive Campaign)
 Home Care
 Home-based Hospice
 Location Outside Facility.
 Specimen Collection Area (Community)

NON-PATIENT CARE LOCATIONS**[0044]**

5 Administrative Areas
 CDC Locations and Descriptions
 Assisted Living Area
 Blood Bank
 Central Sterile Supply
 10 Central Trash Area
 Clinical Chemistry
 Facility Grounds
 General Laboratory
 Hematology Laboratory Histology/Surgical Pathology
 15 Housekeeping/Environmental Services
 Laundry Room
 Microbiology Laboratory
 Morgue/Autopsy Room
 Pharmacy
 20 Physical Plant Operations Center
 Public Area in Facility
 Serology Lab
 Soiled Utility Area
 Virology Laboratory

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Day Parts**[0045]**

30 Day shift - weekday/weekend or holidays
 Night Shift - weekday/weekend or holidays
 First Shift/Second Shift/Third Shift - for both weekdays/weekends or holidays
 First Shift/Second Shift/Third Shift/Fourth Shift/Fifth Shift - for both weekdays/weekends or holidays

35 Predetermined time period during the day

[0046] Once the multi-modal compliance index is calculated a number of different reports could be generated. The reports can be used to help determine where more or different hand hygiene compliance efforts such as additional training need be implemented. The reports could be presented in a simple graph format as shown in figures 2 and 3 wherein figure 2 shows the hand hygiene index in the pediatrics unit as compared to the hospital aggregate and the goal or benchmark and figure 3 shows the hand hygiene index in the intensive care unit as compared to the hospital aggregate and the goal or benchmark. Figure 4 shows some different reporting options. Figure 5 shows a dashboard showing a more comprehensive way of presenting the information.

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[0047] It will be appreciated by those skilled in the art that there are a number of different options in regard to how the hand hygiene compliance index may be presented. A representation of the different ways the hand hygiene compliance index may be presented is shown generally at 100 in figure 4. For example, the user may use a default benchmark 102 or a user defined benchmark 104 when determining the dispenser usage compliance. With the default benchmark the hand hygiene compliance index may be a dispenser usage compliance index on its own 106 or it may include multi-modal data. If it includes multi-modal data the dispenser usage compliance index may be combined with survey data 108; or with direct observation data 110; or with survey data and direct observation data 112. Alternatively with the user defined benchmark the hand hygiene compliance index may be presented as the dispenser usage compliance index on its own 114; or with survey data 116; or with direct observation data 118; or with survey data and direct observation data 120. If the dispenser usage compliance index is combined with other data the data is weighted when it is combined to provide a hand hygiene compliance index.

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[0048] The hand hygiene compliance index (HHCI) may be expressed as an equation. Hand hygiene events or dispenser usage events are used for calculation of the HHCI or the dispenser usage compliance index. An event is the same as a dispenser activation, except in the case where multiple activations occur within a predetermined activation period. The predetermined activation period is between 1 and 4 seconds and preferably 2.5 seconds. Wherein multiple

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activations occur within the predetermined activation period the total activations occurring within the predetermined activation period constitute a single hand hygiene event. In those cases multiple activations within for example 2.5 seconds are recorded as a single event with n activations. The events are what are used for the HHCI numerator.

$$\left(\frac{\sum_s^e \text{events}}{\sum_s^e (\text{census}_{dp} * \text{benchmark}_{dp})} * w_1 \right) + (\text{observed} * w_2) + (\text{survey} * w_3)$$

$$\left(\frac{\sum_s^e \text{events}}{\sum_s^e (\text{census}_{dp} * \text{benchmark}_{dp})} * w_1 \right) + (\text{observed} * w_2) + (\text{survey} * w_3)$$

where:

- e= end date
- s= start date
- events=number of actual hand hygiene events
- dp=day part (e.g. first shift; second shift)
- census=patients for the day part
- benchmark=expected activations for the day part
- w1 =the weighting of the particular component. w1 +w2+w3 must total to exactly 1.
- w2=the weighting of the particular component. w1 +w2+w3 must total to exactly 1.
- w3=the weighting of the particular component. w1 +w2+w3 must total to exactly 1.

[0049] Direct observation method = observed hand hygiene compliance. A whole number between 0 and 100 representing % compliance.

[0050] Patient survey method = patient survey hand hygiene compliance. A whole number between 0 and 100 representing % compliance.

[0051] The numerator is the sum of events for a predetermined time period.

[0052] The denominator represents the total number of expected hand hygiene events for a predetermined time period.

[0053] To calculate the denominator, first take the census for a day part multiplied by the benchmark for that day part. This yields the expected number of events for that day part. The expected events for each day part for the predetermined time period are then added together resulting in the total expected activations for the period of time defined by that start and end time.

[0054] The weightings are applied by multiplying the weighting by the Hand Hygiene compliance of the component.

[0055] There are three cases for calculating Hand Hygiene Compliance.

1) Dispenser Activation

[0056] In this case w1 is equal to 1 and there is no observed or survey Hand Hygiene component to the index.

2) Dispenser Activation and Either Survey or Observed data

[0057] In this case w1 and w2 or w3 will total to 1, and the index is calculated by multiplying the weighting by the compliance component. For example, group monitoring system recorded Hand Hygiene compliance for a period of time is 90 with a weighting of 0.8. Patient Survey compliance is 70 with a weighting of 0.2. With no observed data used for the calculation of the (hand hygiene compliance index) HHCI. Recorded Hand Hygiene Compliance is 90 x 0.8 or 72 and patient survey Hand Hygiene Compliance is 70 x 0.2 or 14. The Hand Hygiene Compliance Index for the period of time is 86, or 72 + 14.

3) Dispenser Activations with both Patient Survey and Observed Compliance Data

[0058] In this case w1 + w2 + w3 will total to 1, and the index is calculated by multiplying the weighting by the compliance component.

[0059] For example, the group monitoring system recorded hand hygiene compliance for a period of time is 90 with a weighting of 0.6. Patient survey compliance is 70 with a weighting of 0.2. and observed data compliance of 70 with a weighting of 0.2. Recorded hand hygiene compliance is 90 x 0.6 or 54 with patient survey hand hygiene compliance is

70 x 0.2 or 14 and observed compliance is 70 x 0.2 or 14. The hand hygiene compliance index for the period of time is 82, or 54 + 14 + 14.

[0060] It will be appreciated by those skilled in the art that there is a wide variety of ways that the information may be presented. A sample dashboard is shown at 130 in figure 5. The sample dashboard includes a graphical representation of the usage 132, a summary report 134 and a chart of specific dispenser usage 136.

[0061] Each dispenser has a unique identifier and the unique identifier which may be associated with a soap dispenser versus a sanitizer dispenser. It may be important to differentiate between hand hygiene events using soap versus sanitizer. This would be particularly important where the facility has a particular outbreak that requires soap versus sanitizer or vice versa such as with the disease causing organism *clostridium difficile* (also known as *c. diff.*) which is most difficult to eliminate in the spore form and can typically be removed from the hands only with hand washing as there is reliable data that supports the premise that hand sanitizers are not an effective way to kill *c. diff.* spores.

[0062] The system may be designed wherein the facility has the ability to adjust the benchmark or use a benchmark of its own choosing. It will be appreciated by those skilled in the art that the facility will have a wide range of reports that they can generate. For example it could generate reports by unit; by hospital; compare unit to unit; unit to hospital; or hospital to hospital by way of example. As well it will be appreciated by those skilled in the art that the dispenser usage data may be integrated with the facility purchasing department.

[0063] The system may be connected with a wired system as shown at 30 in figure 6 or in a wireless system as shown at 50 in figure 7. In the wired system 30 a dispenser 32 is connected to a hub 34 and/or a gateway 36. The gateway is connected to the data collation server 38 which in turn is connected to a hand hygiene compliance index calculation server 40. Those skilled in the art will appreciate that data collation server 38 may comprise one or more computers.

[0064] Similarly in the wireless system 50 the dispenser 52 is wirelessly connected to a hub 54 and/or a gateway 56. The gateway is wirelessly connected to a data collation server 58, preferably over the internet through GSM (Global System for Mobile Communications) or other communications standards and network protocol. The data collation server 58 is connected to a hand hygiene compliance index calculation server 60. It will be appreciated by those skilled in the art that the data collation server 58 and the hand hygiene compliance index calculation server 60 may be the same server. Each dispenser 52 has a sensor therein that preferably is capable of storing data in regard to up to 100 or more activations. It will be appreciated by those skilled in the art that 100 is by way of example only and that typically each dispenser may need to only store data relating to a few activations. This minimizes the chance of losing data in the event of queuing for receipt by the hub. The data is sent between the dispenser 52 and hub 54 and the hub 54 and gateway 56 in bursts which are either time or memory dependent. Preferably, data is sent from the gateway 56 to the server 58 in a burst by way of GSM. Data may be sent to an offsite server 60 for data processing.

[0065] While the network is described as a plurality of network devices consisting of hubs and gateways, other network devices may be used. Some non-limiting examples include wireless hubs, Ethernet hubs, repeater hubs, switches, ethernet switches, bridges, routers, Ethernet routers, wireless routers, and gateway routers.

[0066] Those skilled in the art will appreciate that packets may be sent within the aforementioned network using any number of protocols. Optionally, packets may be sent according to the Internet Protocol Suite (IPS), which includes the Transmission Control Protocol (TCP) and the Internet Protocol (IP), often called TCP/IP. Compared to alternatives, this scheme moves much of the network complexity to the edge of the network, i.e. to each dispenser and to the server. When using this scheme, dispensers may send packets via either TCP or UDP (User Datagram Protocol), though other transport-layer protocols may be used within the IPS specifications.

[0067] Alternatively, packets sent between dispensers, hubs, and gateways may have a defined format different from those specified in the IPS specifications, and may be eventually repackaged into IPS-compatible packets when to the sent off-site server 60. It may be desirable to send information off-site using the Internet Protocol Suite since existing Internet network infrastructure may be used for transmission. When designing a wireless system there are a number of different considerations. Specifically there are only a limited number of frequencies that are generally available for "unlicensed" transmissions. The "unlicensed" frequencies that are available in each country may be different. The "unlicensed" frequencies may have a wide range of uses, for example they are used in tag security systems at retail stores, remote control devices for garages, Wi-Fi networks and many RFID tags (radio frequency identification device tags). Preferably the system described herein would use an "unlicensed" frequency. By way of example in the USA Title 47 Part 15 of the Code of Federal Regulations covers the use of "unlicensed" transmitters within the United States. Specifically, the table below shows the frequency and associated power levels that are generally available.

Frequency Band	Power Level (dBm)	Power (mW)	Notes
216MHz-960MHz	~-10dBm	0.1	Special conditions apply and certain exclusions and exemptions are available

(continued)

Frequency Band	Power Level (dBm)	Power (mW)	Notes
902-928MHz	30dBm	1000	Requires spread spectrum
2400-2484MHz	30dBm	1000	Requires spread spectrum
*200uV/m equates to approximately -10dBm when converted.			

[0068] In contrast the European radio regulations are encapsulated by the R&TTE (Directive 1999/5/EC) and supported by CEPT Recommendation 70-03. Compliance with the R&TTE directive can be achieved in 2 ways the first is through the application of "Harmonized Standards" and the second by obtaining Notified Body Approval. The table below is based on recommendation CEPT70-03 and the Harmonized standards EN300-220 and EN300-440.

Frequency Band	Power Level (dBm)	Power (mW)	Notes
433.050-434.790 MHz	10dBm	10	<10% duty cycle
433.050-434.790 MHz	0dBm	1	-13dBm/10kHz restriction
433.040-434.790 MHz	10dBm	10	25kHz channel spacing
863.870-870 MHz	13.2dBm	20.9	<0.1 % duty cycle
869.700-869.650 MHz	27dBm	501	<10% duty cycle
2400-2483.5 MHz	10dBm	10	No restrictions

[0069] The frequency and power that are chosen will affect the design of the system. A flow diagram showing the steps implemented in a low frequency (between 400 and 450 MHz) low power (up to 10 mW) wireless system is shown by way of a non-claimed example generally at 70 in figure 8. A similar flow diagram for a higher frequency (between 850 and 950 MHz), higher power (up to 1 W) wireless system in accordance with the claimed invention is shown generally at 140 in figure 9.

[0070] A flow diagram showing the steps implemented a low frequency (between 400 and 450 MHz) low power (up to 10 mW) wireless system is shown generally at 70 in figure 8 by way of a non-claimed example. Once there has been a dispenser usage event the dispenser 52 ID is transmitted to any and all hubs 54 within the transmission distance 72. On receipt of the dispenser ID transmission the hub(s) reply with an acknowledgement 74. This is sometimes referred to as a "handshake". If an acknowledgement is not received by the dispenser, the dispenser will retry until it is successful. The hub adds a date and time stamp to the ID to produce dispenser usage data. The hubs 54 send the dispenser usage data 76 on through the hub network unit it reaches a gateway 56. Each successive hub 54 in the chain acknowledges receipt of the dispenser usage data from the previous hub 78. If acknowledgement is not received by the originating hub it will retry until successful. The hubs 54 within the transmission distance of the gateway transmit the dispenser usage data through to the gateway 80. When the activation data is captured by the gateway 56, it transmits an acknowledgement back to the originating hub(s) 82. If an acknowledgement is not received by the originating hub, it will retry until successful. The gateway 56 collates all of the data it received from the rest of the system into transmission packets of a predetermined format. The predetermined format may specify a predetermined size or a predetermined header size. These data packets are transmitted to the data collation server 84. Preferably the data is sent to the collation server 58 over the internet and preferably via GSM. When the data packet is received or captured by the data collation server 58 an acknowledgement is sent back to the gateway 86. If an acknowledgement is not received by the gateway 56, it will retry until successful. This type of system is often referred to as a mesh network.

[0071] It will be appreciated that such acknowledgements may be either dedicated packets or may be included in a designated offset within the header of packets.

[0072] Alternatively, acknowledgements may be sent from the server back to the dispenser, rather than between each hub and dispenser. In this scheme, each hub would forward the acknowledgement packets to their addressed location, e.g. dispenser or server.

[0073] A higher frequency (between 850 and 950 MHz) and higher power (up to 1W) system is shown generally at 140 in figure 9 in accordance with the claimed invention. On set up the dispenser 52 sends out a request to the nearest hub 54 for the hub's ID (identification) and a time update 142. The hub 54 responds with requested information 144 and this synchronizes to the dispenser. If the response is not received by the dispenser, it will retry until a successful synchronization is achieved. Once the set up is complete and there has been a dispenser usage event the dispenser

52 transmits to its synchronized hub 54 dispenser data including, dispenser ID, time, date of use, dispenser usage events 146. On receipt of the dispenser data the hub replies with an acknowledgement 148. The acknowledgement contains a time update. This is sometimes referred to as a "handshake". If an acknowledgement is not received by the dispenser, the dispenser will retry until it is successful. The hubs collate the data received from the dispensers to form a transmission packet of a predetermined size (predetermined number of bytes) 150. The data packet is then transmitted through the hub network until it reaches the gateway 56. As the data packet is captured by the receiving hub it transmits an acknowledgement back to the originating hub 152. This acknowledgement also contains a time update. If an acknowledgement is not received by the originating hub it will retry until successful. The hubs 54, within transmission distance of the gateway 56, transmits the data packets to the gateway 154. As the data packet is captured by the gateway it transmits and acknowledgement back to the originating hub 156. This acknowledgement contains a time update. If acknowledgement is not received by the originating hub it will retry until successful. The gateway collates all of the data it received from the rest of the system into a transmission packet of a predetermined size (bytes) 158. This data packet is then transmitted via GSM to the data collection server 58. As the data packet is captured the data collation server transmits an acknowledgement back to the gateway 160. This acknowledgement also contains a time update. If an acknowledgement is not received by the gateway 56, it will retry until successful. This type of system is often referred to as a mesh network.

[0074] Referring to figures 10 and 11, examples of dispenser data collection system are shown respectively at 90 and 96. A plurality of dispensers 52 are positioned around the unit of the facility being monitored. A plurality of receivers or hubs 54 are positioned around the unit within range of the dispensers such that each dispenser is in range of at least one receiver. As described above, when each dispenser 52 is used it will transmit its unique identification code, date and time to the hub or hubs 54, the hubs 54 in turn transmit the data to a gateway 56 and then to a server 58. Typically in a large facility the system uses a mesh network. At each stage of data transmission there will be a "handshake" between the transmitter and receiver whether that be dispenser and hub, hub and hub, hub and gateway or gateway and server. A handshake confirms the data is received and instructs the dispenser to delete the information from the memory. The server 36 may be on site or off site.

[0075] Accordingly, when designing the system herein for healthcare facility usage, for example a hospital, there are a number of competing interests. Specifically the system will require a plurality (100's or more likely 1,000's) of self (battery) powered activation sensors which need to reliably transmit usage data wirelessly around sprawling, cluttered hospital buildings and the data be transmitted via a GSM link(s) to the internet for external data manipulation. Each sensor's batteries preferably have long life (5+ years), are physically small (< a packet of cards) and preferably the system cost is low. It is preferable that the system not interfere with medical equipment, be legal, and utilize license free radio frequencies.

[0076] A non-claimed example system is to use a low power + low cost + minimal RF interference, this suggests a system along the lines of a Zigbee® / Z wave® type network architecture, utilizing ultra-low power transmitters (typically 0.1 mw) with minimal processing power. This gives low sensor hardware costs (currently approximately \$5/ node) and requires an electrical outlet powered network to be installed in each building to act as a communication and data processing 'backbone'. Knowledge of radio frequency propagation within buildings would lead those skilled in the art to select the lowest available frequency to maximize range for a given power output (reduces the hardwired 'backbone' costs and enhances reliable communications) and consequently he would preferably choose between 400 and 450 MHz. This would give a typical indoor range of 50ft. Such a system is shown by way of example in figure 10 at 90. By way of example, in a facility that needs around 4000 dispensers, 200 hubs are required as shown in figure 10.

[0077] In contrast, legislation allows for higher power transmissions (c. 500 mw) when utilizing direct sequence spread spectrum techniques (DSSS) at higher frequencies (868 - 930 MHz dependant on location); this increases range (typically 330ft) but also cost (currently approximately \$11/ node) and power consumption. However, in another embodiment shown in figure 11 at 96, it has been determined that the reduction in the density of the electrical outlet powered network backbone gives savings that at least offset the increase in sensor cost. The additional power requirements due to the 5,000 fold increase in transmission power are able to be offset by significantly more efficient firmware running in the sensor, enabled by the higher capacity microprocessor that is required to facilitate DSSS. For example by increasing unit cost and output power, in this embodiment there is a significantly decreased system cost and complexity without a noticeable battery life penalty (a single board mounted battery that fits within the space requirement gives preferably a life of 5 years +).

[0078] In system 96, between approximately 20 and 40 hubs is needed with around 4000 dispensers. The distance between the dispenser and the hub can be up to 5740 feet. However inside a healthcare facility the distances are more typically 330 feet and in some cases greater than 330 feet depending on the objects between the dispenser and the hub. Those skilled in the art will appreciate that the maximum number of dispensers per hub will be limited by available network bandwidth and by the number of bits per address. Since each dispenser will have generally low activity on the network, a larger number of dispensers may be supported than on networks in which all devices are continuously active. Implementations of the hubs that use 8-bit addressing will be limited to connecting to 255 dispensers, though other implementations with more bits per address may allow for additional dispensers, e.g. up to 10,000 dispensers. Typically

inside a healthcare facility, each hub will receive data from around 200 dispensers. In system 96 the transmission power is up to 1000 milliwatts. With system 96 higher level data encryption can be used thereby providing a higher level of security than that afforded by the lower frequency system. System 96 uses direct sequence spread spectrum transmission techniques which has a reduced rate of interference and is allowed to operate at higher powers as compared to the lower frequency system.

[0079] Accordingly the higher frequency of the claimed invention, generally between 850 and 950 MHz is advantageous over the lower frequency generally between 400 and 450 MHz system. The higher frequency system uses higher power and higher frequency which is opposite to conventional wisdom in regard to systems of data distribution of this type. Since the dispenser uses more power, some preliminary processing may be conducted at the dispenser.

[0080] A group monitoring system for dispenser usage compliance within a predetermined group of interest in a predetermined facility comprising the steps of: providing a plurality of dispensers, providing a dispenser data collection system operably connected to each dispenser, capable of providing information, the information including a unique dispenser identifier for each dispenser, a number of dispenser usage events that each dispenser was used; receiving the information from the data collection system and determining the predetermined group with which each dispenser is associated; determining the number of hand hygiene events within the predetermined group within a predetermined time period; determining a benchmark which corresponds to dispenser usage opportunities particular to the predetermined group and particular to the predetermined time period; calculating a dispenser usage compliance index particular to the predetermined group and particular to the predetermined time period by dividing the hand hygiene events for the predetermined group and the predetermined time period by a denominator, wherein the denominator equals the benchmark. The number of hand hygiene events within a predetermined time period equals a number of times the dispenser has been activated and wherein multiple activations within a predetermined activation period are considered a single dispenser usage event. It is not uncommon that when someone uses a dispensing system that rather than merely activating once they activate the dispenser multiple times. Accordingly to accurately determine the correct number of times that the dispenser has been used, the number of times the dispenser is activated needs to be determined. However where there are multiple activations within a predetermined activation period that is considered a single dispenser usage event.

[0081] The dispenser usage compliance index may further include at least one of direct observation data or survey data. The data used in the dispenser usage compliance index is weighted. The predetermined time period may correspond to a shift of the predetermined group in the predetermined facility.

[0082] The benchmark will likely vary depending on the predetermined facility, the type of unit in the facility, the time of day, and the day of the week. The denominator may also be the benchmark multiplied by census data. The census data will be dependent on the group of interest and may be bed occupancy, patient days, patient visits, the number of bed-hours of care or the staff. The predetermined group may be a bed, a room, a ward, a unit, a floor or a facility.

[0083] The dispenser data collection system in a non-claimed example uses a frequency of one of between 400 and 450 MHz system and between 850 and 950 MHz system. According to the invention the dispenser data collection system uses a frequency between 850 and 950 MHz system and has a transmission power of up to 1000 milliwatts. It further includes a plurality of hubs for receiving data from the plurality of dispensers and each hub receives data from one or more dispensers and the distance between each dispenser and its associated hub is generally no greater than 5740 feet. The data between the dispenser and the hub is encrypted.

[0084] The group monitoring system for dispenser usage data collection includes a plurality of dispensers; a plurality of hubs each capable of receiving data from one or more dispensers; and wherein the distance between each dispenser and its associated hub is typically no greater than 5740 feet and the data is transmitted at between 850 and 950 MHz.

[0085] Generally speaking, the systems described herein are directed to a dispenser compliance system and by way of example a hand hygiene compliance system. As required, embodiments of the present invention are disclosed herein. However, the disclosed embodiments are merely exemplary, and it should be understood that the invention may be embodied in many various and alternative forms. The Figures are not to scale and some features may be exaggerated or minimized to show details of particular elements while related elements may have been eliminated to prevent obscuring novel aspects. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention. For purposes of teaching and not limitation, the illustrated embodiments are directed to a dispenser usage compliance system.

[0086] As used herein, the terms "comprises" and "comprising" are to be construed as being inclusive and open rather than exclusive. Specifically, when used in this specification including the claims, the terms "comprises" and "comprising" and variations thereof mean that the specified features, steps or components are included. The terms are not to be interpreted to exclude the presence of other features, steps or components.

Claims

1. A system for monitoring dispenser usage compliance within a predetermined group of interest in a predetermined facility type, the system comprising:

a plurality of dispensers (52);
 a wireless dispenser data collection system operably connected to each dispenser, the dispenser data collection system configured to provide information, the information including a unique dispenser identifier for each dispenser and a number of dispenser usage events that each dispenser was used,
 wherein the dispenser data collection system is configured to use a frequency between 850 and 950MHz and a transmission power of up to 1W,
 the dispenser data collection system comprises a plurality of hubs (54), a gateway (56) and a server (58), wherein each dispenser is configured to, during a set up phase, send out a request to the nearest hub for the hub's identification and a time update, wherein each hub is configured to respond to such a request with the requested information to thereby synchronize to the dispenser, wherein each dispenser is configured to, during the set up phase and if a response from the hub is not received, retry sending out said request until a successful synchronisation with the hub is achieved, wherein each dispenser is configured to, once the set up phase is complete and there has been a dispenser usage event, transmit to its synchronised hub dispenser usage data including, dispenser ID, time, date of use and dispenser usage events, wherein each hub is configured to, on receipt of the dispenser usage data, reply with an acknowledgment containing a time update, wherein each dispenser is configured to, if said acknowledgment is not received, retry transmitting the dispenser usage data until said acknowledgment is received, and, if said acknowledgment is received, delete the dispenser usage data from its memory;
 wherein each hub is configured to collate the data received from the dispensers to form a data packet of a predetermined size and transmit the data packet through the hub network until it reaches the gateway, wherein each receiving hub is configured to transmit an acknowledgment back to the originating hub upon receipt of the data packet, the acknowledgement containing a time update, and wherein the gateway is configured to transmit an acknowledgement back to the originating hub upon receipt of the data packet, the acknowledgement containing a time update, wherein each hub is configured to, if an acknowledgment from a receiving hub or the gateway is not received, retry transmitting the data packet until said acknowledgment is received;
 the gateway is configured to collate all the data received from the rest of the dispenser data collection system to form a data packet of a predetermined size and transmit the data packet to the server, wherein the server is configured to transmit an acknowledgment back to the gateway upon receipt of the data packet, the acknowledgement containing a time update, wherein the gateway is configured to, if an acknowledgment from the server is not received, retry transmitting the data packet until said acknowledgment is received
 wherein the server is configured to:

receive the information from the data collection system and determine the predetermined group of interest within which each dispenser is associated;
 determine the number of dispenser usage events within the predetermined group of interest within a predetermined time period;
 calculate a dispenser usage compliance index particular to the predetermined group of interest and particular to the predetermined time period by dividing the dispenser usage events for the predetermined group of interest and the predetermined time period by a denominator wherein the denominator equals a benchmark which corresponds to dispenser usage opportunities particular to the predetermined group of interest and particular to the predetermined time period; and
 automatically generate a report comprising the calculated dispenser usage compliance index.

2. The system of claim 1 wherein the report further comprises a representation of a comparison between the calculated dispenser usage compliance index and one or more of an aggregate dispenser usage compliance index for a hospital and the benchmark.
3. The system of any preceding claim wherein the server (58) is further configured to receive further data, and combine the further data with the information before calculating a hand hygiene compliance index;
 wherein the further data is selected from survey data and direct observation data.
4. The system of any preceding claim wherein the dispenser data collection system comprises a plurality of gateways (56).

5. The system of any preceding claim wherein the dispensers (52) are configured to encrypt the dispenser usage data to be transmitted.

6. A method of monitoring dispenser usage compliance within a predetermined group of interest in a predetermined facility type comprising a plurality of dispensers (52) and a wireless dispenser data collection system comprising a plurality of hubs (54), a gateway (56) and a server (58), the dispenser data collection system being operatively connected to each dispenser, providing information including a unique dispenser identifier for each dispenser and a number of dispenser usage events that each dispenser was used and using a frequency between 850 and 950MHz and a transmission power of up to 1W, the method comprising the steps of:

during a set up phase of the dispenser data collecting system each dispenser sending out a request to the nearest hub for the hub's identification and a time update, wherein each hub responds to such a request with the requested information to thereby synchronize to the dispenser, wherein each dispenser, during the set up phase and if a response from the hub is not received, retries sending out said request until a successful synchronisation with the hub is achieved, wherein each dispenser, once the set up phase is complete and there has been a dispenser usage event, transmits to its synchronised hub dispenser usage data including, dispenser ID, time, date of use and dispenser usage events, wherein each hub, on receipt of the dispenser usage data, replies with an acknowledgment containing a time update, wherein each dispenser, if said acknowledgment is not received, retries transmitting the dispenser usage data until said acknowledgment is received, and, if said acknowledgment is received, deletes the dispenser usage data from its memory;

collating at each hub the data received from the dispensers to form a data packet of a predetermined size and transmit the data packet through the hub network until it reaches a gateway, wherein each receiving hub transmits an acknowledgment back to the originating hub upon receipt of the data packet, the acknowledgement containing a time update, and wherein the gateway transmits an acknowledgment back to the originating hub upon receipt of the data packet, the acknowledgement containing a time update, wherein each hub, if an acknowledgment from a receiving hub or a gateway is not received, retries transmitting the data packet until said acknowledgment is received;

collating at the gateway all the data received from the rest of the dispenser data collection system to form a data packet of a predetermined size and transmit the data packet to the server, wherein the server transmits an acknowledgment back to the gateway upon receipt of the data packet, the acknowledgement containing a time update, wherein the gateway, if an acknowledgment from the server is not received, retries transmitting the data packet until said acknowledgment is received;

the server receiving the information from the data collection system and determining the predetermined group of interest within which each dispenser is associated;

the server

determining the number of dispenser usage events within the predetermined group of interest within a predetermined time period;

the server calculating a dispenser usage compliance index particular to the predetermined group of interest and particular to the predetermined time period by dividing the dispenser usage events for the predetermined group of interest and the predetermined time period by a denominator wherein the denominator equals a benchmark which corresponds to dispenser usage opportunities particular to the predetermined group of interest and particular to the predetermined time period; and

the server automatically generating a report comprising the calculated dispenser usage compliance index.

7. The method of claim 6 wherein the report further comprises a representation of a comparison between the calculated dispenser usage compliance index and one or more of an aggregate dispenser usage compliance index for a hospital and the benchmark.

8. The method of any of claims 6 or 7 further comprising the server (58) receiving further data, and combining the further data with the information before calculating a hand hygiene compliance index; wherein the further data is selected from survey data and direct observation data.

9. The method of any of claims 6 to 8 wherein the data collection system further comprises a plurality of gateways (56).

10. The method of any of claims 6 to 9 wherein the dispenser usage data transmitted by the dispensers (52) is encrypted.

Patentansprüche

1. System zum Überwachen der Spenderbenutzungs-Compliance innerhalb einer vorbestimmten interessierenden Gruppe in einer vorbestimmten Art von Einrichtung, wobei das System umfasst:

eine Vielzahl von Spendern (52);
 ein drahtloses Spenderdatenerfassungssystem, das funktionsfähig mit jedem Spender verbunden ist, wobei das Spenderdatenerfassungssystem derart konfiguriert ist, dass es Daten bereitstellt, wobei diese Daten eine eindeutige Spenderkennung für jeden Spender sowie eine Anzahl von Spenderbenutzungsereignissen, bei denen jeder Spender benutzt wurde, beinhalten,
 wobei das Spenderdatenerfassungssystem derart konfiguriert ist, dass es eine Frequenz zwischen 850 und 950 MHz und eine Sendeleistung von bis zu 1 W verwendet,
 das Spenderdatenerfassungssystem eine Vielzahl von Hubs (54), ein Gateway (56) und einen Server (58) umfasst,
 wobei jeder Spender derart konfiguriert ist, dass er während einer Einrichtungsphase an den nächstgelegenen Hub eine Anfrage nach der Identifizierung dieses Hubs und einer aktualisierten Zeit sendet, wobei jeder Hub derart konfiguriert ist, dass er auf eine solche Anfrage hin mit den angeforderten Informationen antwortet und sich so mit dem Spender synchronisiert, wobei jeder Spender derart konfiguriert ist, dass er, während der Einrichtungsphase und falls keine Antwort von dem Hub empfangen wird, das Senden der Anfrage wiederholt, bis eine erfolgreiche Synchronisation mit dem Hub erfolgt ist, wobei jeder Spender derart konfiguriert ist, dass er, sobald die Einrichtungphase abgeschlossen ist und
 ein Spenderbenutzungsereignis vorliegt, an seinen synchronisierten Hub Spenderbenutzungsdaten einschließlich Spenderkennung, Zeit, Datum der Benutzung und Spenderbenutzungsereignisse überträgt, wobei jeder Hub derart konfiguriert ist, dass er bei Empfang der Spenderbenutzungsdaten mit einer Bestätigung einschließlich einer aktualisierten Zeit antwortet, wobei jeder Spender derart konfiguriert ist, dass er, falls keine solche Bestätigung empfangen wird, die Übertragung der Spenderbenutzungsdaten erneut versucht, bis die Bestätigung empfangen wird, und bei Empfang der Bestätigung dann die Spenderbenutzungsdaten aus seinem Speicher löscht;
 wobei jeder Hub derart konfiguriert ist, dass er die von den Spendern empfangenen Daten zu einem Datenpaket einer vorbestimmten Größe zusammenfasst und das Datenpaket durch das Hub-Netzwerk sendet, bis es das Gateway erreicht, wobei jeder empfangende Hub derart konfiguriert ist, dass er bei Empfang des Datenpakets eine Bestätigung zurück an den Ausgangs-Hub sendet, wobei die Bestätigung eine aktualisierte Zeit enthält, und wobei das Gateway derart konfiguriert ist, dass es bei Empfang des Datenpakets eine Bestätigung zurück an das Ausgangs-Hub sendet, wobei die Bestätigung eine aktualisierte Zeit enthält, wobei jedes Hub derart konfiguriert ist, dass es, falls keine Bestätigung von einem empfangenden Hub oder dem Gateway empfangen wird, die Übertragung des Datenpakets erneut versucht, bis die Bestätigung empfangen wird;
 das Gateway derart konfiguriert ist, dass es alle vom Rest des Spenderdatenerfassungssystems empfangenen Daten zu einem Datenpaket einer vorbestimmten Größe zusammenfasst und das Datenpaket an den Server überträgt, wobei der Server derart konfiguriert ist, dass er bei Empfang des Datenpakets eine Bestätigung zurück an das Gateway überträgt, wobei die Bestätigung eine aktualisierte Zeit enthält, wobei das Gateway derart konfiguriert ist, dass es, falls keine Bestätigung vom Server empfangen wird, erneut versucht, das Datenpaket zu übertragen, bis die Bestätigung empfangen wird, wobei der Server derart konfiguriert ist, die Informationen vom Datenerfassungssystem zu empfangen und die vorbestimmte interessierende Gruppe zu bestimmen, innerhalb der jeder Spender zugeordnet ist;
 die Anzahl der Spenderbenutzungsereignisse innerhalb der vorbestimmten interessierenden Gruppe innerhalb einer vorbestimmten Zeitspanne zu bestimmen;
 einen Compliance-Index für die Spenderbenutzung zu berechnen, der für die vorbestimmte interessierende Gruppe und für die vorbestimmte Zeitperiode charakteristisch ist, indem die Spenderbenutzungsereignisse für die vorbestimmte interessierende Gruppe und für die vorbestimmte Zeitperiode durch einen Nenner geteilt werden, wobei der Nenner einer Benchmark entspricht, die den Spenderbenutzungsmöglichkeiten entspricht, wie sie für die vorbestimmte interessierende Gruppe und für die vorbestimmte Zeitperiode charakteristisch sind; und
 automatisch einen Bericht erstellt, der den berechneten Compliance-Index für die Spenderbenutzung enthält.

2. System nach Anspruch 1, bei dem der Bericht des Weiteren eine Darstellung eines Vergleichs zwischen dem berechneten Compliance-Index für die Spenderbenutzung und mindestens entweder einem Compliance-Index für die Spender-Gesamtbenutzung für ein Krankenhaus oder der Benchmark, oder beidem, umfasst.

3. System nach einem der vorhergehenden Ansprüche, bei dem der Server (58) des Weiteren derart konfiguriert ist, dass er weitere Daten empfängt und die weiteren Daten mit den Informationen kombiniert, bevor er einen Compliance-Index für die Handhygiene berechnet; wobei die weiteren Daten aus Erhebungsdaten und direkten Beobachtungsdaten ausgewählt sind.

4. System nach einem der vorhergehenden Ansprüche, bei dem das Spenderdatenerfassungssystem eine Vielzahl von Gateways (56) umfasst.

5. System nach einem der vorhergehenden Ansprüche, bei dem die Spender (52) derart konfiguriert sind, dass sie die zu übertragenden Spenderbenutzungsdaten verschlüsseln.

6. Verfahren zum Überwachen der Spenderbenutzungs-Compliance innerhalb einer vorbestimmten interessierenden Gruppe in einer vorbestimmten Art von Einrichtung mit einer Vielzahl von Spendern (52) und einem drahtlosen Spenderdatenerfassungssystem, das eine Vielzahl von Hubs (54), ein Gateway (56) und einen Server (58) umfasst,

wobei das Spenderdatenerfassungssystem betriebsmäßig mit jedem Spender verbunden ist, Informationen einschließlich einer eindeutigen Spenderkennung für jeden Spender und einer Anzahl von Spenderbenutzungsereignissen, bei denen jeder Spender benutzt wurde, bereitstellt und eine Frequenz zwischen 850 und 950 MHz und eine Sendeleistung von bis zu 1W verwendet,

wobei das Verfahren folgende Schritte umfasst:

während einer Einrichtungsphase des Spenderdatenerfassungssystems sendet jeder Spender an den nächstliegenden Hub eine Anfrage nach der Identifizierung dieses Hubs und einer aktualisierten Zeit, wobei jeder Hub auf eine solche Anfrage mit den angeforderten Informationen antwortet und sich so mit dem Spender synchronisiert, wobei jeder Spender während der Einrichtungsphase und falls keine Antwort vom Hub empfangen wird, das Aussenden der Anfrage wiederholt, bis eine erfolgreiche Synchronisation mit dem Hub erfolgt ist, wobei jeder Spender, bei abgeschlossener Einrichtungsphase und bei Vorliegen eines Spenderbenutzungsereignisses, an seinen synchronisierten Hub Spenderbenutzungsdaten einschließlich Spenderkennung, Uhrzeit, Datum der Benutzung und

Spenderbenutzungsereignisse sendet,

wobei jeder Hub bei Empfang der Spenderbenutzungsdaten mit einer Bestätigung antwortet, die eine aktualisierte Zeit enthält, wobei jeder Spender, bei Ausbleiben der Bestätigung, die Übertragung der Spenderbenutzungsdaten wiederholt, bis die Bestätigung empfangen wird, und bei Empfang der Bestätigung die Spenderbenutzungsdaten dann aus seinem Speicher löscht;

Zusammenfassen an jedem Hub der von den Spendern empfangenen Daten zu einem Datenpaket einer vorbestimmten Größe und Senden des Datenpakets durch das Hub-Netzwerk, bis es ein Gateway erreicht, wobei jeder empfangende Hub bei Empfang des Datenpakets eine Bestätigung zurück an den Ausgangs-Hub sendet, wobei die Bestätigung eine aktualisierte Zeit enthält, und wobei das Gateway bei Empfang des Datenpakets eine Bestätigung zurück an das Ausgangs-Hub sendet, wobei die Bestätigung eine aktualisierte Zeit enthält, wobei jedes Hub, falls keine Bestätigung von einem empfangenden Hub oder einem Gateway empfangen wird, die Übertragung des Datenpakets erneut versucht, bis die Bestätigung empfangen wird;

Zusammenfassen aller vom Rest des Spenderdatenerfassungssystems empfangenen Daten am Gateway zu einem Datenpaket einer vorbestimmten Größe, und Übertragen des Datenpakets an den Server, wobei der Server bei Empfang des Datenpakets eine Bestätigung zurück an das Gateway überträgt, wobei die Bestätigung eine aktualisierte Zeit enthält, wobei das Gateway, falls keine Bestätigung vom Server empfangen wird, das Übertragen des Datenpakets wiederholt, bis die Bestätigung empfangen wird;

Empfangen der Informationen vom Datenerfassungssystem und Bestimmen der vorbestimmten interessierenden Gruppe, innerhalb der jeder Spender zugeordnet ist, am Server;

Bestimmen der Anzahl der Spenderbenutzungsereignisse innerhalb der vorbestimmten interessierenden Gruppe innerhalb einer bestimmten Zeitspanne am Server;

Berechnen eines Compliance-Index für die Spenderbenutzung durch den Server, der für die vorbestimmte interessierende Gruppe und für die vorbestimmte Zeitperiode charakteristisch ist, indem die Spenderbenutzungsereignisse für die vorbestimmte interessierende Gruppe und für die vorbestimmte Zeitperiode durch einen Nenner geteilt werden, wobei der Nenner einer Benchmark entspricht, die den Spenderbenutzungsmöglichkeiten entspricht, wie sie für die vorbestimmte interessierende Gruppe und für die vorbestimmte Zeitperiode charakteristisch sind; und

automatisches Erstellen eines Berichts durch den Server, der den berechneten Compliance-Index für die

Spenderbenutzung enthält.

7. Verfahren nach Anspruch 6, bei dem der Bericht des Weiteren eine Darstellung eines Vergleichs zwischen dem berechneten Compliance-Index für die Spenderbenutzung und mindestens entweder einem Compliance-Index für die Spender-Gesamtbenutzung für ein Krankenhaus oder der Benchmark, oder beidem, umfasst.
8. Verfahren nach einem der Ansprüche 6 oder 7, des Weiteren umfassend, seitens des Servers (58), das Empfangen weiterer Daten, und
 - das Kombinieren der weiteren Daten mit den Informationen vor dem Berechnen eines Compliance-Index für die Handhygiene;
 - wobei die weiteren Daten aus Erhebungsdaten und direkten Beobachtungsdaten ausgewählt sind.
9. Verfahren nach einem der Ansprüche 6 bis 8, bei dem das Spenderdatenerfassungssystem des Weiteren eine Vielzahl von Gateways (56) umfasst.
10. Verfahren nach einem der Ansprüche 6 bis 9, bei dem die von den Spendern (52) übermittelten Spenderbenutzungsdaten verschlüsselt sind.

Revendications

1. Système pour surveiller une conformité d'utilisation de distributeurs au sein d'un groupe d'intérêt prédéterminé dans un type d'installation prédéterminé, le système comprenant :

- une pluralité de distributeurs (52) ;
- un système de collecte de données de distributeur sans fil connecté fonctionnellement à chaque distributeur, le système de collecte de données de distributeur étant configuré pour fournir des informations, les informations incluant un unique identificateur de distributeur pour chaque distributeur et un nombre d'événements d'utilisation de distributeur pour lesquels chaque distributeur a été utilisé ;
- dans lequel le système de collecte de données de distributeur est configuré pour utiliser une fréquence comprise entre 850 et 950 MHz et une puissance de transmission allant jusqu'à 1W ;
- le système de collecte de données de distributeur comprend une pluralité de concentrateurs (54), une passerelle (56) et un serveur (58), dans lequel chaque distributeur est configuré pour, pendant une phase d'établissement, envoyer une demande au concentrateur le plus proche pour l'identification du concentrateur et une mise à jour d'heure, dans lequel chaque concentrateur est configuré pour répondre à une telle demande avec les informations demandées pour se synchroniser par conséquent avec le distributeur, dans lequel chaque distributeur est configuré pour, pendant la phase d'établissement et si une réponse du concentrateur n'est pas reçue, réessayer d'envoyer ladite demande jusqu'à ce qu'une synchronisation réussie avec le concentrateur soit réalisée, dans lequel chaque distributeur est configuré pour, une fois que la phase d'établissement est terminée et qu'il y a eu un événement d'utilisation de distributeur, transmettre, à son concentrateur synchronisé, des données d'utilisation de distributeur incluant l'identificateur de distributeur, l'heure, la date d'utilisation et les événements d'utilisation de distributeur, dans lequel chaque concentrateur est configuré pour, suite à la réception des données d'utilisation de distributeur, répondre avec un accusé de réception contenant une mise à jour d'heure, dans lequel chaque distributeur est configuré pour, si ledit accusé de réception n'est pas reçu, réessayer de transmettre les données d'utilisation de distributeur jusqu'à ce que ledit accusé de réception soit reçu, et, si ledit accusé de réception est reçu, supprimer les données d'utilisation de distributeur de sa mémoire ;
- dans lequel chaque concentrateur est configuré pour rassembler les données reçues des distributeurs, en vue de former un paquet de données d'une taille prédéterminée et transmettre le paquet de données à travers le réseau de concentrateurs jusqu'à ce qu'il atteigne la passerelle, dans lequel chaque concentrateur de réception est configuré pour retransmettre un accusé de réception au concentrateur d'origine suite à la réception du paquet de données, l'accusé de réception contenant une mise à jour d'heure, et dans lequel la passerelle est configurée pour retransmettre un accusé de réception au concentrateur d'origine suite à la réception du paquet de données, l'accusé de réception contenant une mise à jour d'heure, dans lequel chaque concentrateur est configuré pour, si un accusé de réception provenant d'un concentrateur de réception ou de la passerelle n'est pas reçu, réessayer de transmettre le paquet de données jusqu'à ce que ledit accusé de réception soit reçu ;
- la passerelle est configurée pour rassembler toutes les données reçues en provenance du reste du système de collecte de données de distributeur en vue de former un paquet de données d'une taille prédéterminée et

transmettre le paquet de données au serveur, dans lequel le serveur est configuré pour retransmettre un accusé de réception à la passerelle suite à la réception du paquet de données, l'accusé de réception contenant une mise à jour d'heure, dans lequel la passerelle est configurée pour, si un accusé de réception en provenance du serveur n'est pas reçu, réessayer de transmettre le paquet de données jusqu'à ce que ledit accusé de réception soit reçu ;
dans lequel le serveur est configuré pour :

recevoir les informations en provenance du système de collecte de données et déterminer le groupe d'intérêt prédéterminé dans lequel chaque distributeur est associé ;
déterminer le nombre d'événements d'utilisation de distributeur dans le groupe d'intérêt prédéterminé au cours d'une période de temps prédéterminée ;
calculer un indice de conformité d'utilisation de distributeur spécifique au groupe d'intérêt prédéterminé et spécifique à la période de temps prédéterminée, en divisant les événements d'utilisation de distributeur pour le groupe d'intérêt prédéterminé et la période de temps prédéterminée par un dénominateur, dans lequel le dénominateur est égal à un repère de référence qui correspond aux opportunités d'utilisation de distributeur spécifiques au groupe d'intérêt prédéterminé et spécifiques à la période de temps prédéterminée ; et
générer automatiquement un rapport comprenant l'indice de conformité d'utilisation de distributeurs calculé.

2. Système selon la revendication 1, dans lequel le rapport comprend en outre une représentation d'une comparaison entre l'indice de conformité d'utilisation de distributeur calculé et un ou plusieurs éléments parmi un indice de conformité d'utilisation de distributeur agrégé pour un hôpital et le repère de référence.

3. Système selon l'une quelconque des revendications précédentes, dans lequel le serveur (58) est en outre configuré pour recevoir des données supplémentaires, et à combiner les données supplémentaires avec les informations avant de calculer un indice de conformité d'hygiène des mains ;
dans lequel les données supplémentaires sont sélectionnées parmi des données d'enquête et des données d'observation directe.

4. Système selon l'une quelconque des revendications précédentes, dans lequel le système de collecte de données de distributeur comprend une pluralité de passerelles (56).

5. Système selon l'une quelconque des revendications précédentes dans lequel les distributeurs (52) sont configurés de manière à chiffrer les données d'utilisation de distributeur à transmettre.

6. Procédé de surveillance d'une conformité d'utilisation de distributeurs au sein d'un groupe d'intérêt prédéterminé dans un type d'installation prédéterminé comprenant une pluralité de distributeurs (52) et un système de collecte de données de distributeur sans fil comprenant une pluralité de concentrateurs (54), une passerelle (56) et un serveur (58), le système de collecte de données de distributeur étant connecté fonctionnellement à chaque distributeur, fournissant des informations incluant un unique identificateur de distributeur pour chaque distributeur et un nombre d'événements d'utilisation de distributeur pour lesquels chaque distributeur a été utilisé, et utilisant une fréquence comprise entre 850 et 950 MHz et une puissance de transmission allant jusqu'à 1 W, le procédé comprenant les étapes ci-dessous dans lesquelles ou consistant à :

pendant une phase d'établissement du système de collecte de données de distributeur, chaque distributeur envoie une demande au concentrateur le plus proche pour l'identification du concentrateur et une mise à jour d'heure, dans lequel chaque concentrateur répond à une telle demande avec les informations demandées pour se synchroniser par conséquent avec le distributeur, dans lequel chaque distributeur, pendant la phase d'établissement, et si une réponse du concentrateur n'est pas reçue, tente à nouveau d'envoyer ladite demande jusqu'à ce qu'une synchronisation réussie avec le concentrateur soit réalisée, dans lequel chaque distributeur, une fois que la phase d'établissement est terminée et qu'il y a eu un événement d'utilisation de distributeur, transmet, à son concentrateur synchronisé, des données d'utilisation de distributeur incluant l'identificateur de distributeur, l'heure, la date d'utilisation et les événements d'utilisation de distributeur, dans lequel chaque concentrateur, suite à la réception des données d'utilisation de distributeur, répond avec un accusé de réception contenant une mise à jour d'heure, dans lequel chaque distributeur, si ledit accusé de réception n'est pas reçu, tente à nouveau de transmettre les données d'utilisation de distributeur jusqu'à ce que ledit accusé de réception soit reçu, et, si ledit accusé de réception est reçu, supprime les données d'utilisation de distributeur de sa mémoire ;

rassembler, au niveau de chaque concentrateur, les données reçues en provenance des distributeurs, en vue de former un paquet de données d'une taille prédéterminée et transmettre le paquet de données à travers le réseau de concentrateurs jusqu'à ce qu'il atteigne une passerelle, dans lequel chaque concentrateur de réception retransmet un accusé de réception au concentrateur d'origine, suite à la réception du paquet de données, l'accusé de réception contenant une mise à jour d'heure, et dans lequel la passerelle retransmet un accusé de réception au concentrateur d'origine, suite à la réception du paquet de données, l'accusé de réception contenant une mise à jour d'heure, dans lequel chaque concentrateur, si un accusé de réception provenant d'un concentrateur de réception ou d'une passerelle n'est pas reçu, tente à nouveau de transmettre le paquet de données jusqu'à ce que ledit accusé de réception soit reçu ;

rassembler, au niveau de la passerelle, toutes les données reçues en provenance du reste du système de collecte de données de distributeur, en vue de former un paquet de données d'une taille prédéterminée et de transmettre le paquet de données au serveur, dans lequel le serveur retransmet un accusé de réception à la passerelle, suite à la réception du paquet de données, l'accusé de réception contenant une mise à jour d'heure, dans laquelle la passerelle, si un accusé de réception en provenance du serveur n'est pas reçu, tente à nouveau de transmettre le paquet de données jusqu'à ce que ledit accusé de réception soit reçu ;

le serveur reçoit les informations en provenance du système de collecte de données et détermine le groupe d'intérêt prédéterminé dans lequel chaque distributeur est associé ;

le serveur détermine le nombre d'événements d'utilisation de distributeur dans le groupe d'intérêt prédéterminé au cours d'une période de temps prédéterminée ;

le serveur calcule un indice de conformité d'utilisation de distributeur spécifique au groupe d'intérêt prédéterminé et spécifique à la période de temps prédéterminée, en divisant les événements d'utilisation de distributeur pour le groupe d'intérêt prédéterminé et la période de temps prédéterminée par un dénominateur, dans lequel le dénominateur est égal à un repère de référence qui correspond aux opportunités d'utilisation de distributeur spécifiques au groupe d'intérêt prédéterminé et spécifiques à la période de temps prédéterminée ; et

le serveur génère automatiquement un rapport comprenant l'indice de conformité d'utilisation de distributeur calculé.

7. Procédé selon la revendication 6, dans lequel le rapport comprend en outre une représentation d'une comparaison entre l'indice de conformité d'utilisation de distributeur calculé et un ou plusieurs éléments parmi un indice de conformité d'utilisation de distributeur agrégé pour un hôpital et le repère de référence.

8. Procédé selon l'une quelconque des revendications 6 et 7, comprenant en outre l'étape dans laquelle le serveur (58) reçoit des données supplémentaires et combine les données supplémentaires avec les informations avant de calculer un indice de conformité d'hygiène des mains ;

dans lequel les données supplémentaires sont sélectionnées parmi des données d'enquête et des données d'observation directe.

9. Procédé selon l'une quelconque des revendications 6 à 8, dans lequel le système de collecte de données comprend en outre une pluralité de passerelles (56).

10. Procédé selon l'une quelconque des revendications 6 à 9, dans lequel les données d'utilisation de distributeur transmises par les distributeurs (52) sont chiffrées.

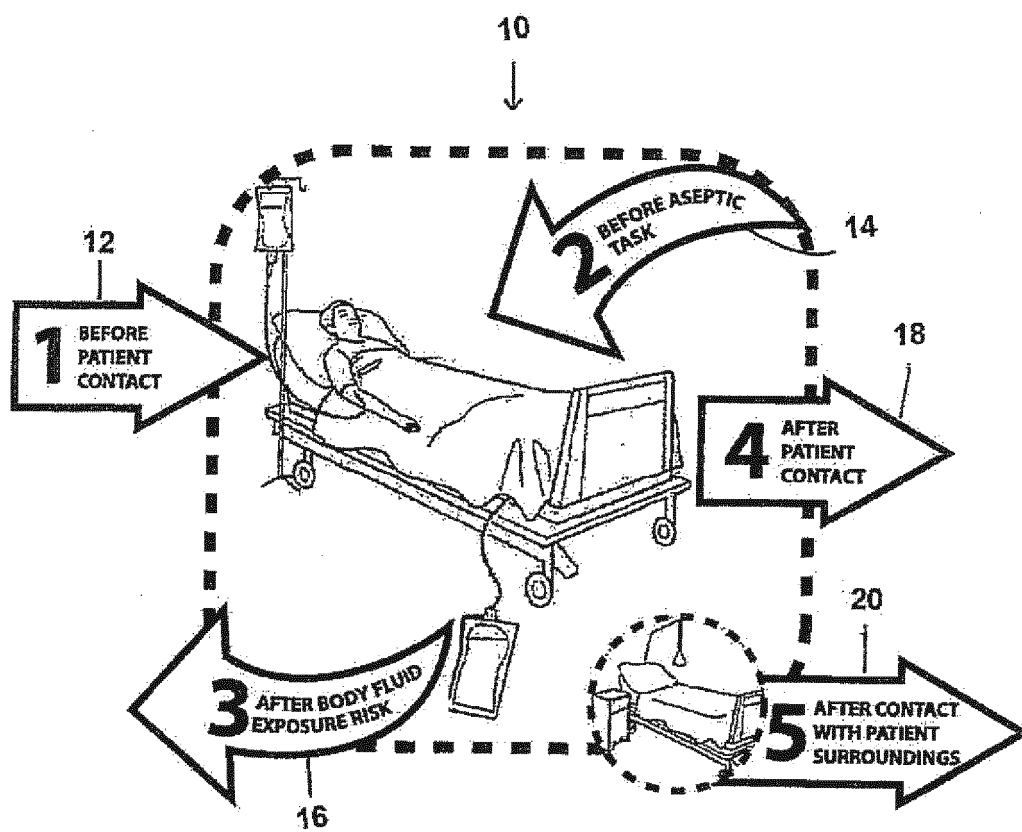


FIG. 1

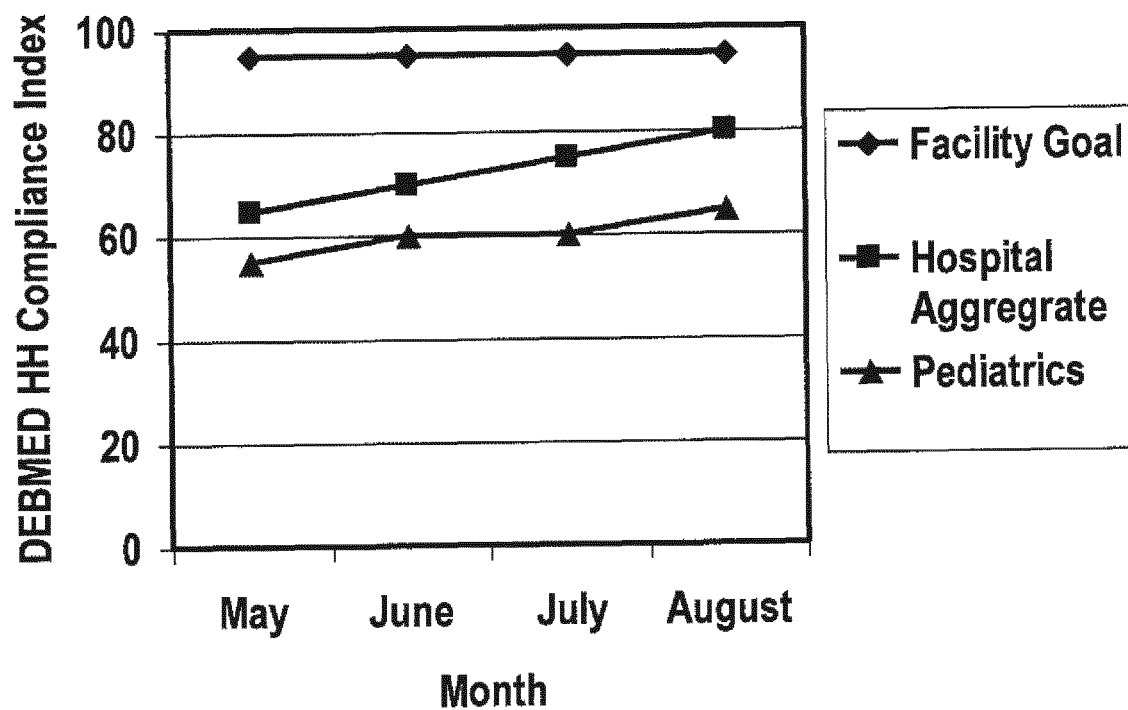


FIG. 2

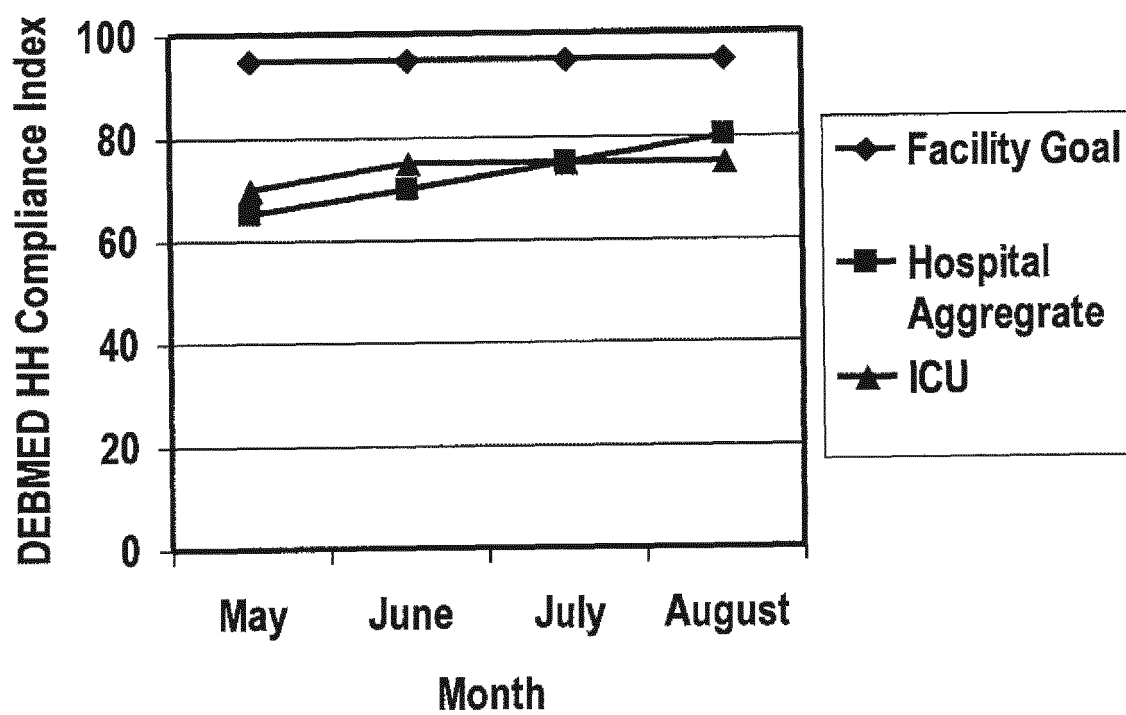


FIG. 3

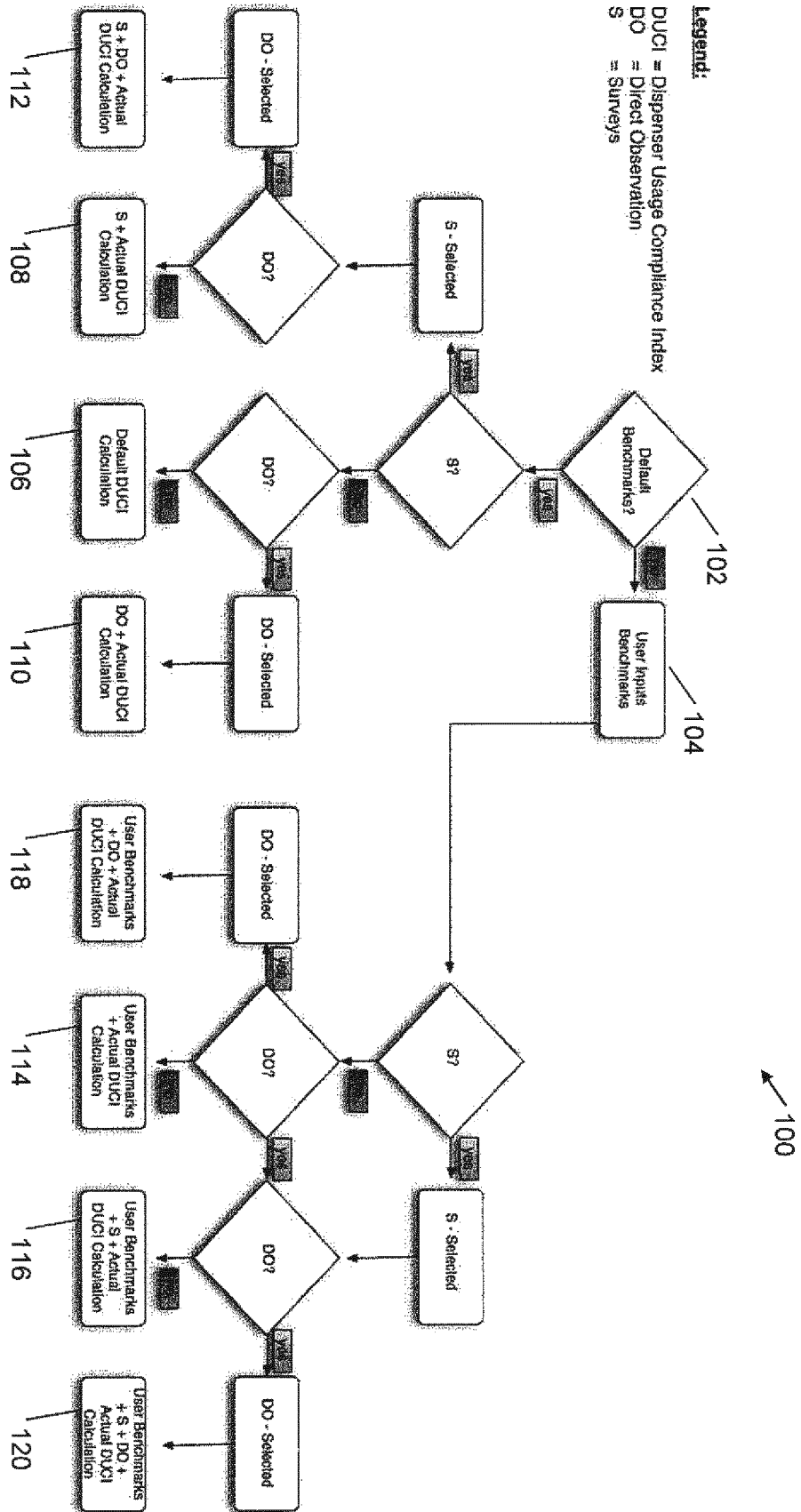


FIG. 4

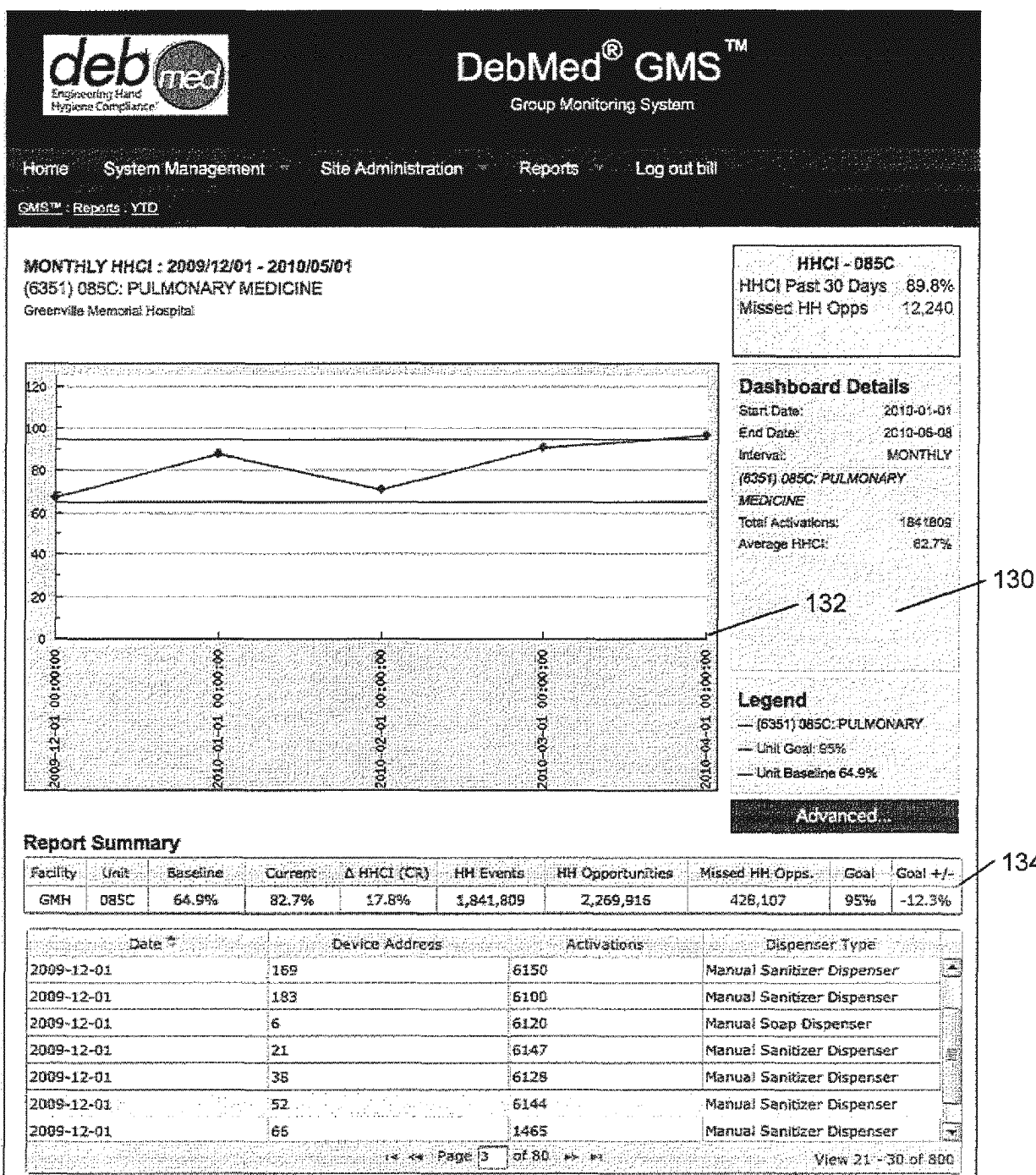


FIG. 5

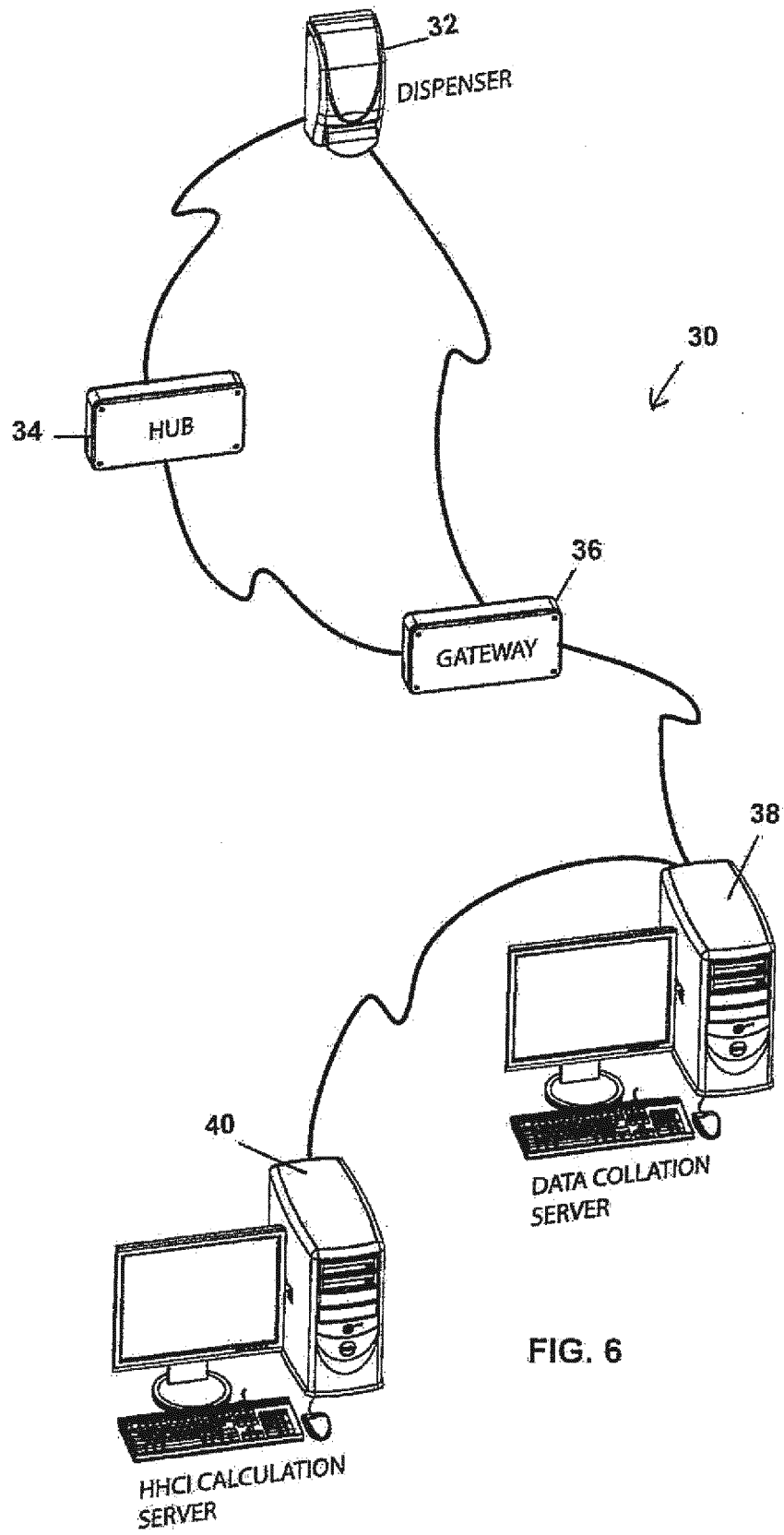
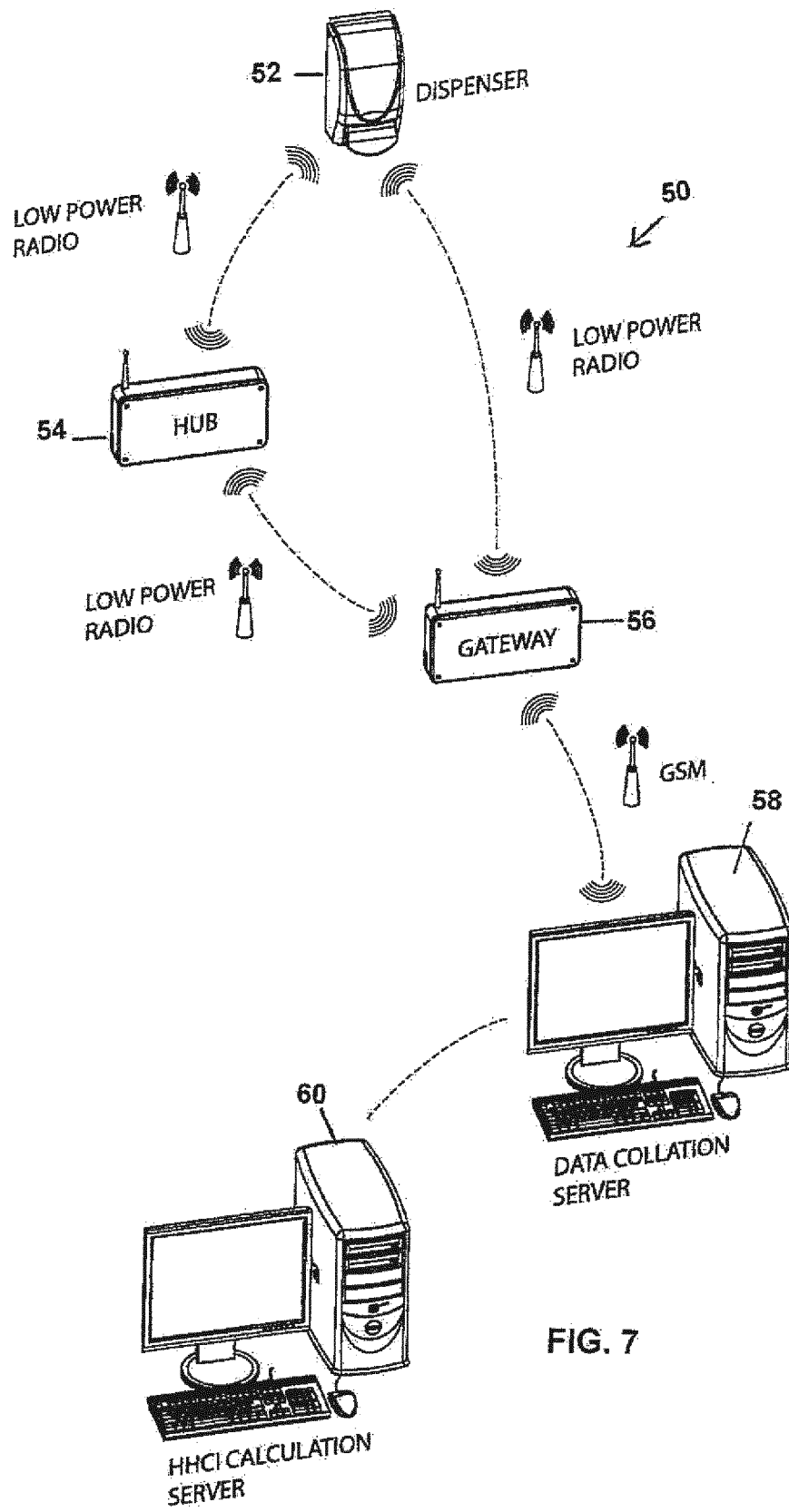


FIG. 6



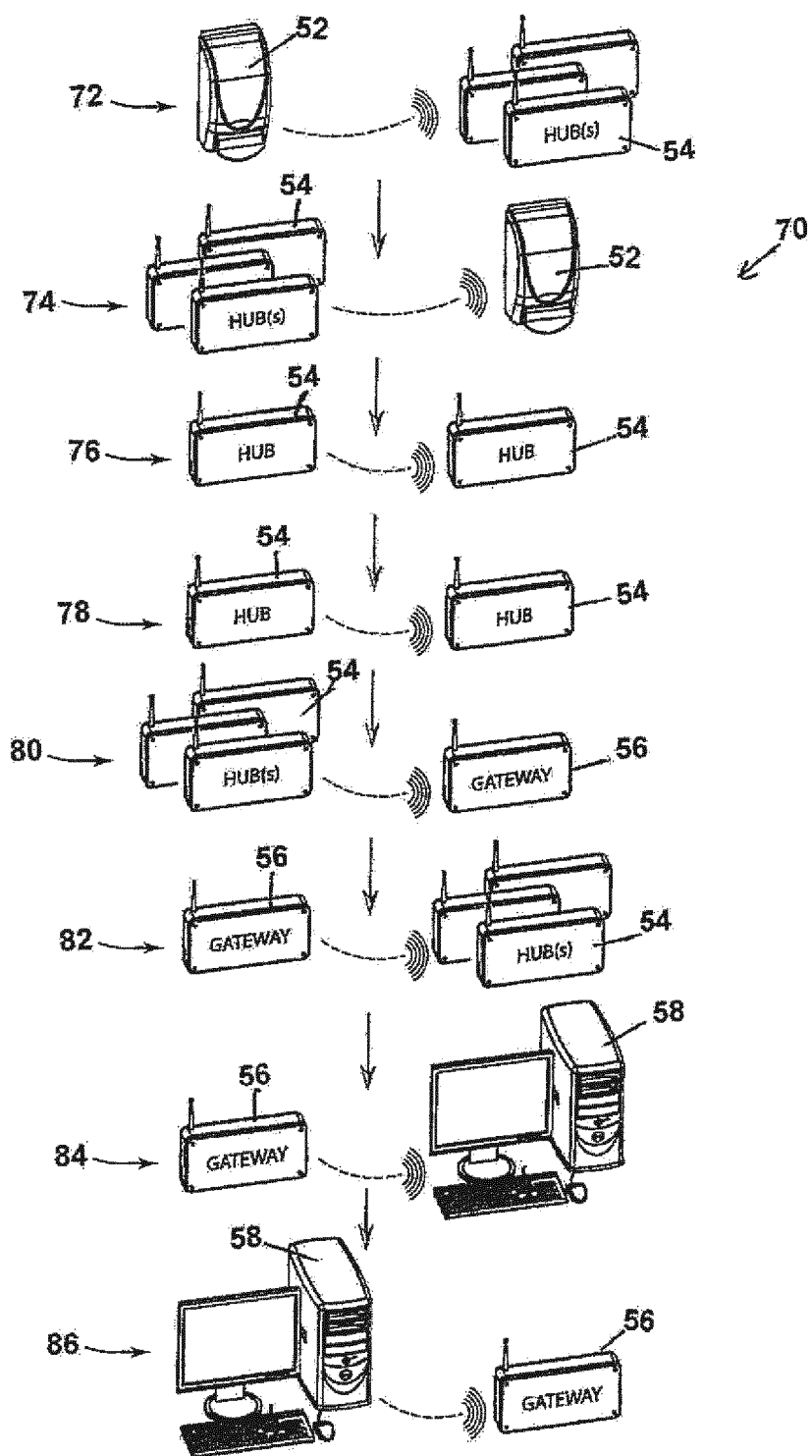


FIG. 8

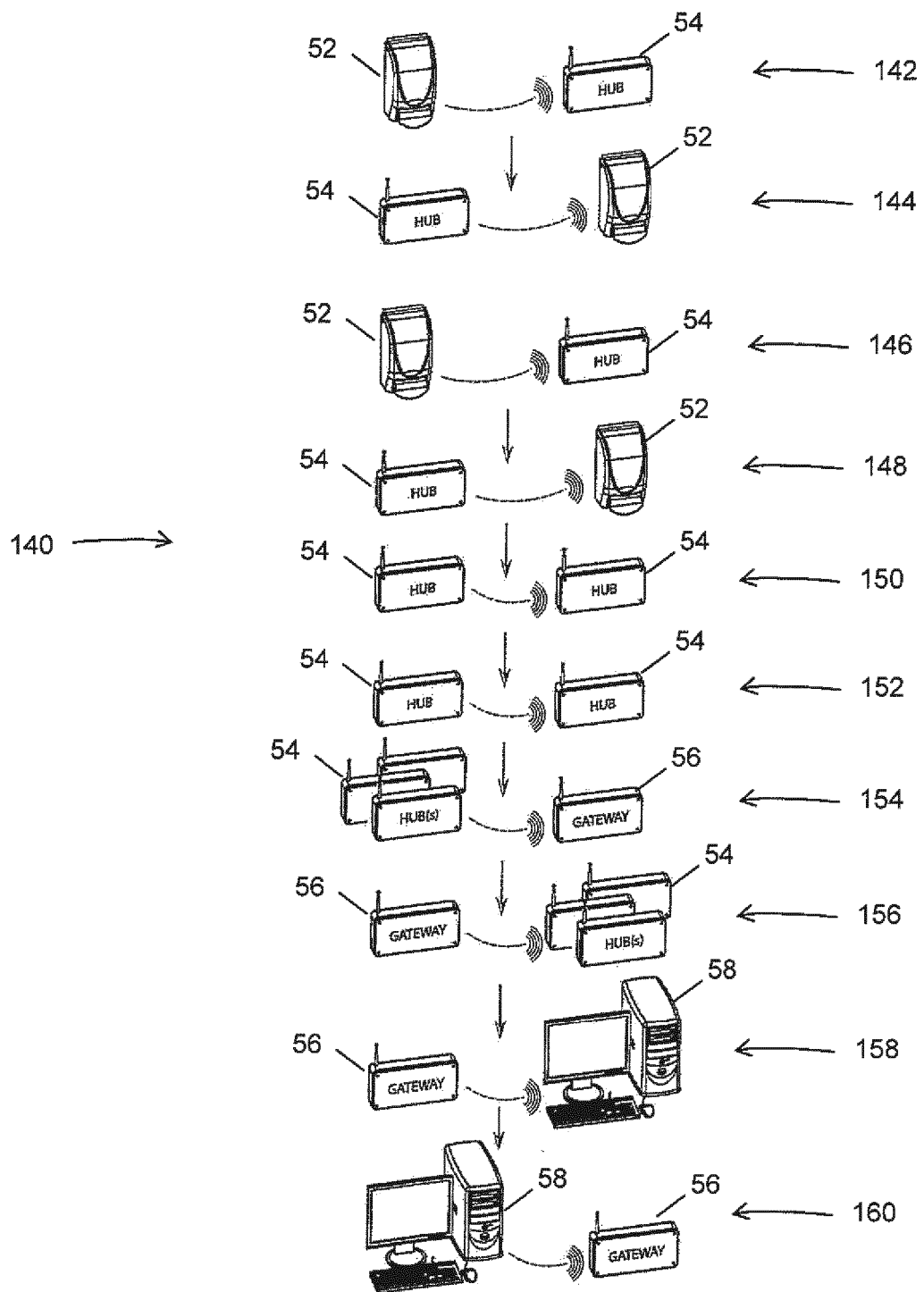


FIG 9

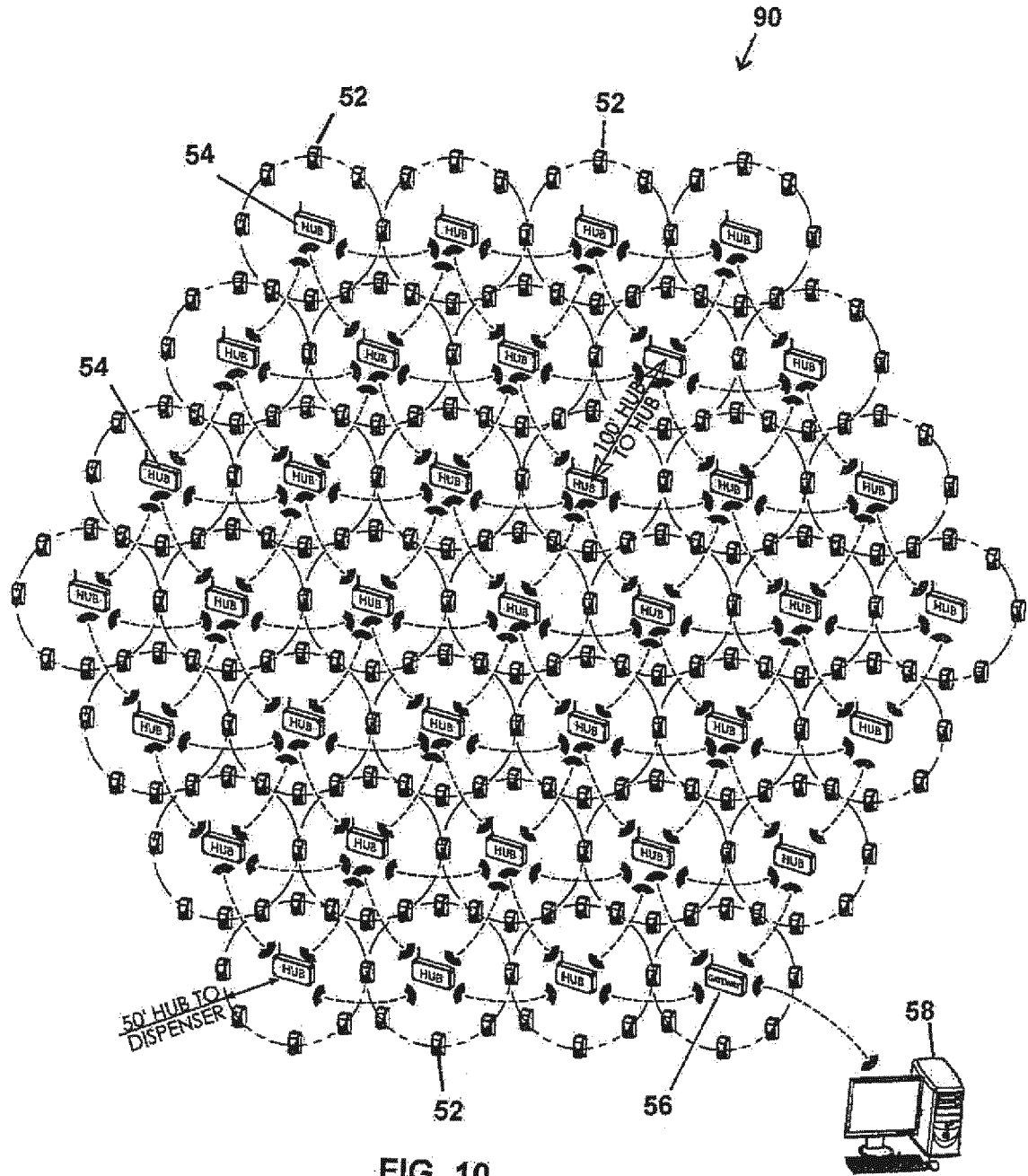


FIG. 10

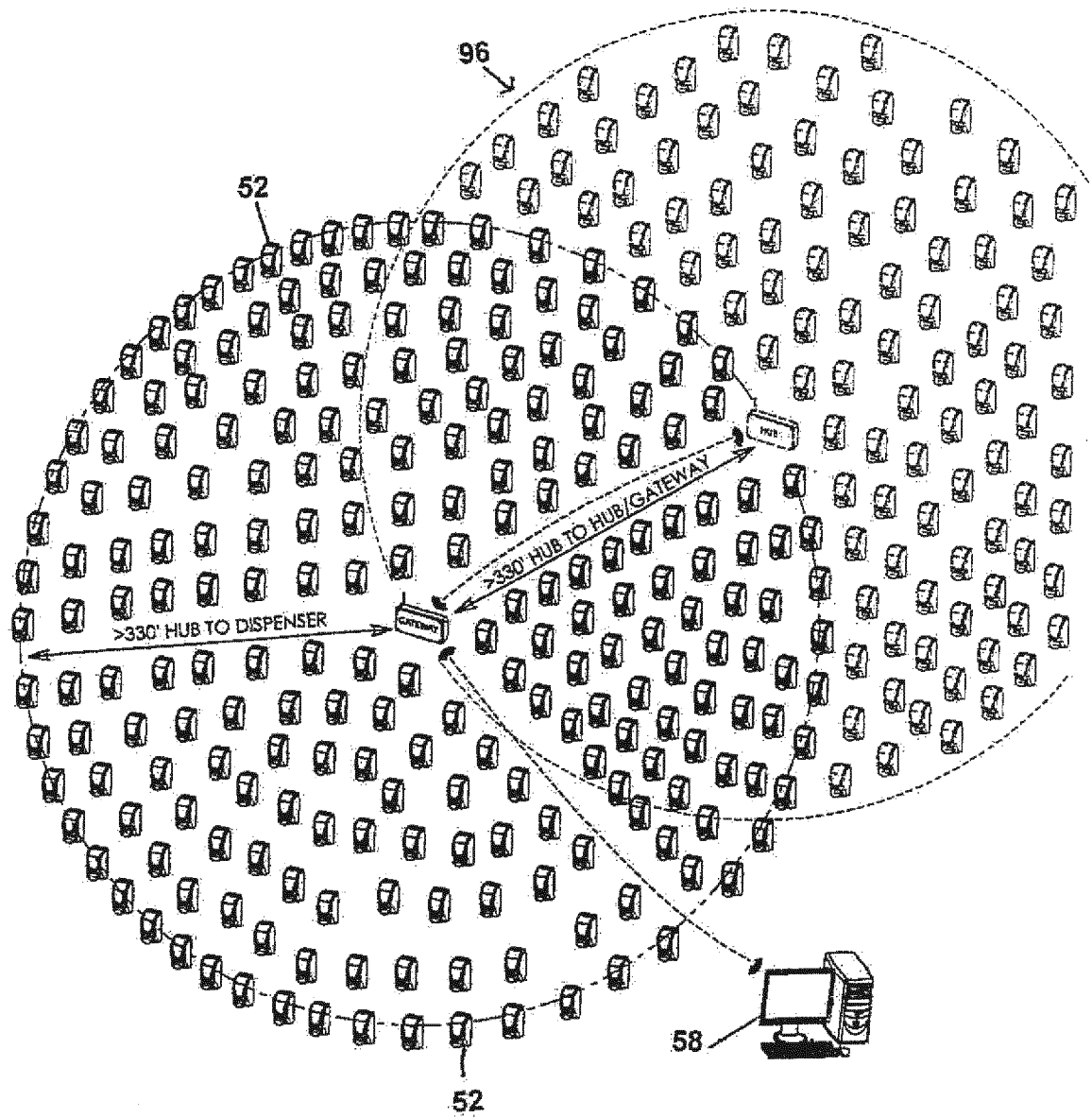


FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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